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## A REVIEW OF THE EELS OF THE PHILIPPINE ARCHIPELAGO

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ELEVEN PLATES AND FOURTEEN TEXT FIGURES

This review contains descriptions of all the eels, or apodal fishes, known from the Philippine Archipelago. Two orders are here treated, although the first order may have no real affinity with the true eels. The first order contains two genera and two species; the second order, twenty-three genera and sixty-one species, including one new genus and eight new species. The eel-like catfishes, blennies, and gobies, more or less abundant in the streams and along the coasts of the Philippines, are not here considered.

The eels form a readily recognizable group, although until the skeletal characters are better known we cannot be certain that we have not grouped together some unrelated families under the larger of the two orders here treated. While all eels are more or less edible, some of them, especially the *Anguillidae*, or fresh-water eels, and the congers, are much esteemed and form an important part of the food supply of the Islands. Eels are caught with nets, in the ever-present *baclad*, or fish corral, and with hook and line, and they occur in large numbers at times in the *bangos* fishponds about Manila Bay, but most of them are captured with some form of *bobo*, or woven bamboo trap.

As would naturally be surmised, the eels of the Philippines are East Indian, most of the species occurring from India to the South Sea Islands. In spite of their great abundance about the

coral reefs, our knowledge of the distribution of many species is still very defective. Certain genera have been neglected by collectors, while the fishermen fear and, therefore, make little attempt to catch the large, fiercely biting, snakelike morays.

In preparing this paper Jordan's Genera of Fishes and The Fishes of the Indo-Australian Archipelago by Weber and Beaufort have been of great assistance. No attempt has been made to make the synonymy complete in all respects.

### Order SYNBRANCHIA

This group of serpentlike fishes is of degraded type and unknown relationships, but is probably closely related to the Apodes, having the body naked or with minute cycloid scales.

The mouth is of the ordinary fish type, the maxillary, premaxillary, and palatine bones being well developed, while in the typical forms the shoulder girdle is joined to the head; in one family, the Amphipnoidæ of India, it is distinct from the skull as in the true eels. There are no paired fins, while the rudimentary vertical fins are reduced to mere folds of skin. The gills may be well developed or they may be rudimentary; in the latter case there is an accessory breathing apparatus, consisting of a respiratory air sac or sacs in the neck, behind the head and communicating with the gill cavity. The gill openings are confluent in a single ventral slit. There is no air bladder, and the stomach has neither a blind sac nor pyloric cæcæ. The skull is solid, and the bones are firmly united; the vertebræ are numerous, unmodified, with ribs present; the anal opening is far back in the posterior half, and the ovaries have oviducts.

This order includes a small number of eel-like fishes widely distributed in tropical fresh and brackish waters and along the coasts of warm seas. Four families of divergent structure are known; representatives of two of them occur in the Philippines. They are both scaleless, without accessory breathing apparatus, and have the shoulder girdle attached to the skull.

#### *Key to the families.*

<i>a<sup>1</sup>.</i> Gill arches three, gills rudimentary.....	Monopteridæ.
<i>a<sup>2</sup>.</i> Gill arches four, gills well developed.....	Synbranchidæ.

### MONOPTERIDÆ

#### RICE-FIELD EELS

Body elongate, naked, tail short and tapering to a point; margin of upper jaw formed by premaxillaries, the maxillaries well

developed but lying behind and parallel with them; lips thick; palatine teeth small, in a narrow band; gill membranes nearly entirely united to isthmus by a median septum which divides gill opening; gill arches three, with rudimentary gill fringes, and moderately wide slits between them; dorsal and anal fins reduced to mere folds; vertebrae  $100 + 88 = 188$ .

Eel like fishes of the rice ditches, rivers, and brackish water, from Burma and the East Indies to North China, Korea, Formosa, and the Riu Kiu Islands.

#### Genus FLUTA Bloch and Schneider

*Fluta* BLOCH and SCHNEIDER, Syst. Ichth. (1801) 565.

*Monopterus* Lacépède is preoccupied by *Monopteros* Volta, Ichth. Veronesi (1796), a genus of fossil fishes.

Characters of the genus included above.

#### *Fluta alba* (Zuieuw).

*Muraena alba* ZUIEUW, Nov. Act. Acad. Sci. Petropol. 7 (1789) 299, pl. 7, fig. 2.

*Monopterus javanois* LACÉPÈDE, Hist. Nat. Poiss. 2 (1798) 139.

*Monopterus javanensis* SCHNEIDER, Syst. Ichth. (1801) 565, after Lacépède; BLEEKER, Atlas Ichth. Muraen. 4 (1864) 118, pl. 47, fig. 1; GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 14.

*Monopterus albus* JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 838, Riu Kiu Islands; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 413, figs. 210 and 211.

Head 13 in length, its depth greater than that of body,  $1\frac{1}{2}$  in its length; depth 22 (17 to 26) in length. Jaws heavy, the lower shorter; maxillary 2 in head; teeth small, mostly uniserial. Eye very small, over middle of maxillary. Gill openings inferior, confluent in a semicircular slit. Tail very short, pointed,  $2\frac{3}{4}$  in rest of body.

Dorsal fin very low, rayless, beginning close behind vent. Anal similar, very indistinct, about half length of dorsal; no pectorals or ventrals. Color in spirits blackish olive, with traces of darker and paler streaks and mottlings, a dark cross band behind head; in life with yellowish streaks and dark dots above.

Length 1 to 2 feet.

The above description is copied from Jordan and Snyder's Apodal Fishes of Japan. No specimens have been seen by me from the Philippines, but the species is recorded by Fowler.<sup>1</sup> His specimen is in the Philadelphia Commercial Museum and is merely labeled "Philippine Islands."

According to Weber and Beaufort "this fish is capable of living a considerable time out of water and of burying itself in the mud when the water is drying up."

<sup>1</sup> Copeia No. 58 (June 18, 1918) 62.

Undoubtedly occurs in the Philippines in the fresh-water streams and rice paddies of the larger islands.

### SYNBRANCHIDÆ

General characters as in the Monopteridæ, but differing in some important particulars.

Instead of three, there are four branchial arches, bearing well-developed gills with wide slits between them, while the gill membranes are free from the isthmus. There are six branchiostegals. Teeth of maxillaries, vomer, and palatine in one to several rows, those of the vomer-palatine region in an arched band. There is no accessory breathing sac. Eye is small, covered by skin. The dorsal and anal are reduced to rayless folds of skin.

#### Genus *SYNBRANCHUS* Bloch

*Synbranchus* BLOCH, Naturgesch. der Ausl. Fische 9 (1795) 86; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 415.

Characters of the genus included above. Occurring throughout the rainy tropics, in both fresh and brackish water.

#### *Synbranchus bengalensis* (McClelland).

*Ophisternon bengalensis* McCLELLAND, Apod. Fishes Bengal, Calcutta Journ. Nat. Hist. 5 (1845) 197, 200, pl. 2, figs. 1 and 2.

*Synbranchus bengalensis* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 119, pl. 48, fig. 1; WEBER and BEAUFORT, Fishes Indo-Austr. 3 (1916) 416, fig. 213.

*Synbranchus bengalensis* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 16; DAY, Fishes of India (1878-88) pl. 167, fig. 2.

Depth a little over 21 to 30 in total length, head 8.75 to almost 12; tail 3.25 to a little more than 4 in total length, and not "nearly 4 times in head and trunk" as stated by Weber and Beaufort; eye small, near tip of snout, and 15 to more than 20 in length of head; mouth oblique, 3 to 3.5 in head, with lips folded back over both jaws, not merely the lower one as stated by authors; snout short, blunt, about one-third the cleft of mouth; posterior nostrils small oval to circular openings on top of head and back of pupil of eye; anterior nostrils minute openings in tip of snout; fins usually low and inconspicuous, the dorsal commencing slightly in advance of the gill opening; lateral line conspicuous.

The cylindrical body elongate and snakelike, with anal opening very far back; tail strongly compressed, tapering, and short.

The color of living specimens varies from very dark olive green to very dark wine red, with belly and chin paler.

Alcoholic specimens are generally uniform dark purplish blackish, but may be very dark brown or reddish brown. A number of preserved specimens examined have the tail so strongly compressed as to present a marked contrast to the body, with broad, white-margined dorsal and anal fins, so that it greatly resembles in appearance the tail of certain salamanders; the height of the dorsal may be from a third to a half of the tail beneath.

I have examined several hundred living specimens and have kept a number in both salt- and fresh-water aquaria. They are apparently very sluggish animals, and remain motionless for hours, either buried in the mud or with the head and half or more of the body raised high above the bottom, much as is the habit of "tomato worms" and other large sphingid larvæ. In the Sambali language they are called *talé-rec*, because of this habit. In many Philippine languages they are called *palos* or *palus*, a word applied to all small eels, especially those of brackish water, but not ordinarily applied to the fresh-water eels. They love to lie partially buried in the mud, with only the tail visible. When disturbed they usually swim off tail first, a procedure which I regard as a protective device, since an enemy would naturally seize upon the wiggling tail. If the tip of the tail were bitten off, the head and trunk, more or less buried in the mud, would easily escape.

I have also examined numerous preserved specimens in the collections of the University of the Philippines, the Philippine Normal School, the Ateneo de Manila, and of Mr. Alejo Arce. Most of them are from Manila Bay, but Mr. Arce's specimen is from Baybay Creek, a tributary of Lake Buhi, while some of those in the University of the Philippines collection are from Apo Reef, west of Mindoro.

This species is evidently abundant and widely distributed in the Philippines but, in common with a number of fresh-water fishes, has been overlooked by collectors. It was first collected here by Jagor in Quingua River near Calumpit, Pampanga.<sup>2</sup> Casto De Elera reported it from Navotas, Manila Bay, while Günther also mentions a specimen in the British Museum as being from the Philippine Islands. It is occasionally brought

<sup>2</sup> Peters, Monatsber. Akad. Wiss. Berlin (1868) 275.

alive to the Manila markets in considerable numbers, being caught in the *bangos* fishponds of Bulacan and Pampanga.

According to Day it reaches a length of several feet. My specimens range in length from 191 to 415 millimeters. This is a fish of shallow seas, coastal waters, and estuaries, particularly where brackish, and it ascends rivers, mostly within or near the influence of the tides. It is known from India eastward to the Philippines, New Guinea, and Dampier Archipelago on the coast of West Australia.

### Order APODES

#### EELS

This order includes bony fishes with the premaxillaries greatly reduced or absent, the maxillaries lateral, and the body eel-like, without ventral fins, and either naked or with vestigial or very small scales. The pectoral arch is not attached to the skull, and pectoral fins may be present or absent. The intermaxillaries are represented by a bony plate bearing teeth, which fills in the space anteriorly between the dentigerous maxillaries which form the upper jaw. When present the caudal fin is united with the dorsal and anal, the fins never being spinous. The vertebræ are numerous and not specially modified, those of the tail remaining in a straight line to its extremity—isocercal.

When very young the eels are translucent ribbon-shaped creatures of the oceanic abysses or the open sea. These larval forms were long known as *Leptocephali*, and pass through a series of changes before assuming the adult form. *Leptocephalus*, however, can no longer be used as a name for larval eels and isospondylous fishes, but under the rules of synonymy must be restricted to the conger eels.

Simplicity of structure in the eels is not an indication of primitiveness but is evidently the result of degeneration of the mouth parts and fins. The Apodes seem to be an offshoot from the soft-rayed fishes, and their divergence from them is, as a whole, a retrogression.

This is a large order, of great interest to the systematic zoölogist, the evolutionist, the geographer, the ecologist, the food economist, and the business man. Some representatives occur in all tropical and temperate regions, and in both fresh and salt water, but the species are mostly marine. They particularly abound about tropical reefs and often have very beautiful or

bizarre coloration. The species found in fresh waters and cool seas or in oceanic depths are always of plain and dark or silvery coloration. Many of the reef-dwelling eels strikingly resemble snakes and worms, in both external appearance and habits. They vary greatly in size from those like earthworms or intestinal round worms up to huge serpentlike forms more than 3 meters in length. Many genera and species have been described but, owing to our very limited knowledge of their breeding habits, larval development, and the changes due to sexual maturity and old age, many of the published species are merely nominal or include two or more species. It is my belief that further collecting will increase the number of valid species in the Philippines to seventy-five or eighty.

*Key to the suborders and families of Apodes known from the Philippines.*

- a<sup>1</sup>. Gill openings well developed, leading to large interbranchial slits; tongue present; opercles and branchial bones well developed; scapular arch present and free from the skull..... Suborder Enchelycocephali.
- b<sup>1</sup>. Skin covered with embedded linear or narrowly oblong scales; anterior nostrils on top of snout, posterior ones in front of eyes; pectorals well developed as are the vertical fins which are confluent with caudal; lower jaw projecting; tongue with its margins free; teeth in cardiform bands on jaws and vomer; eggs minute.... *Anguillidæ*.
- b<sup>2</sup>. Scales wholly wanting; eggs of moderate size, so far as known, much as in ordinary fishes; pectorals present or absent; nostrils marginal, lateral, or superior.
- c<sup>1</sup>. Tail not greatly shorter than rest of body; heart close behind gills.
- d<sup>1</sup>. Nostrils lateral or superior.
  - e<sup>1</sup>. Tongue broad, free anteriorly and on sides; dorsal, anal, and caudal well developed and confluent; tail sometimes ending in a long filament; coloration nearly always plain, blackish, brownish, or silvery, fins often black margined; teeth moderate.
  - f<sup>1</sup>. Pectorals vestigial or absent; snout obtuse, very short, the lower jaw projecting; cleft of mouth strongly oblique; body excessively elongated, depth 48 to 80 in length; needlelike teeth in bands..... *Heterocongridæ*.
  - f<sup>2</sup>. Pectorals well developed; body moderately elongate, depth 14 to 26 in length; lower jaw more or less included; teeth in bands, those on sides forming a cutting edge.

*Leptocephalidæ*.

- e<sup>2</sup>. Tongue narrow, not free; vomerine teeth usually well developed, often enlarged. Pectoral fins well developed; dorsal, anal, and caudal well developed and confluent; upper jaw prominent, its rounded tip separated by a notch from rest of snout; vomer with numerous large conspicuous canines.

*Muraenesocidæ*.

- d*<sup>2</sup>. Anterior nostrils in a short tube at margin of upper lip; posterior nostrils usually in upper lip in a valve, flap, or slit just forward of or below eye and opening downward.
- g*<sup>1</sup>. Caudal present and confluent with dorsal and anal; anus in anterior half of length..... *Myridæ*.
- g*<sup>2</sup>. Caudal absent; tip of tail not threadlike and projecting beyond dorsal and anal when these are present; anus far back, before or behind middle of body..... *Ophichthyidæ*.
- c*<sup>2</sup>. Tail much shorter than rest of body; heart far behind gills; nostrils superior; dorsal and anal confined to tail, confluent with caudal, and often reduced to a low fold..... *Moringuidæ*.
- a*<sup>2</sup>. Gill openings small, more or less circular or horizontal slits, widely separated; tongue wanting or closely adnate; opercles feebly developed; fourth gill arch modified, strengthened, and supporting pharyngeal jaws; skull very narrow..... Suborder *Colocephali*.
- b*<sup>2</sup>. Pectorals wanting; dorsal and anal more or less developed or vestigial, confluent with caudal, covered with thick skin; teeth in two, three, or more rows when dorsal and anal are vestigial or absent; often large and strikingly colored..... *Muraenidae*.

### ANGUILLIDÆ

#### TRUE EELS

Local names; Bagobo, *casili*; Bicol, *casili*, *borirauan*; Bontoc Igorot, *tjalid*; Ibanag, *quiuo-t*, *siking*; Ilocano, *quoet*, *igat*; Ivatan, *tuna*, applied to all kinds of eels; Moro, *casili*; Pampangan, *talunasan*, *palus*; Sambali, *talunasan*, *talunajan*; Tagalog, *igat*, *pabucangbinhi*; Tirurei, *berrirro*; Visayan, *casili*, *bais*.

This is the most primitive family of living eels and is composed of a single genus of plain dark-colored elongate fishes, characterized especially by having very small, more or less linear-oblong rudimentary scales, occurring in small groups and placed separately at right angles to the adjacent groups. They are found in fresh and brackish waters of the temperate and tropical regions except those of the western coast of North America, the west coast of Africa, and South America. The "electric eels" of the tropical fresh waters of the last-named continent are related to the catfishes.

Additional characters are as follows: Body elongate, subcylindrical, becoming laterally compressed behind; lateral line well developed; head long, conical, more or less pointed, the small eye well forward and over angle of mouth; teeth small, conical, mostly uniform in size, in rather wide bands on each jaw and a long patch on vomer; tongue free at tip, lips thick and full with a free margin behind, attached by a frenum in front, the lower jaw more or less projecting; gill openings rather small, slitlike, vertical, about as wide as base of the well-devel-

oped pectorals, lying below and just in front of these; nostrils superior, well separated, the anterior with a small tube; origin of dorsal some distance from head, vertical fins confluent with caudal; vent just before anal.

Perhaps fifty species of *Anguilla* have been described, most of them based upon individual differences due to age or sex, and it is probable that the number now recognized may be still further reduced. Until the fresh-water eels of the world are monographed by some one having before him a complete series of specimens in all stages of growth, we may safely admit as valid one European, one North American, one Japanese, and five or six Indo-Pacific species, eight or nine in all.

The Indo-Pacific species of *Anguilla* are the best defined of the genus and attain by far the largest size. These gigantic eels play an important part in the mythology of some of the Polynesians, as the Samoans and Maoris, and among the Malayans, as the people of Celebes and the hill people of Mindanao and northern Luzon. Among the Lepanto Igorots the eel cult is well developed. Near the town of Kágubátan at the foot of the sacred mountain Múgao, are several small lakes or ponds in which are many large sacred eels. The fish are fed every day with rice and sweet potatoes brought by children of the neighborhood, who sing a song which acts as a signal for the eels to come and be fed. In this song they ask the eels to take the food, to bestow good health upon the givers, and to protect them from sickness. The people say "our fathers had these eels" and "it would be death to the person injuring one," while the springs would dry up and there would be no water for the rice terraces. Another aspect of their relations to man is given in the charming little fairy tale "Talia" of northern Benguet, translated by Prof. Otto Scheerer.<sup>3</sup>

Superstitions concerning eels are widespread among the Christian Filipinos. They say the eel contains a magical stone, or *mutya*, which gives the possessor the power to escape from any knots or fastenings. This is evidently a form of the widespread belief in the bezoar stone, but in this case the slippery agility of the eel is transferred to the owner of the *mutya*. Such Filipino names as *talunasan* refer to the slipperiness of the eel. Some people also believe that if eels are eaten when one is recovering from an illness the disease will attack him again with the utmost severity, and death will be almost sure to follow.

<sup>3</sup> Philip. Journ. Education 2 (1920) 193-202.

Since some kinds of eels are oily and more indigestible than many other fishes, this belief is evidently founded on sound observations but faulty deductions. The convalescent dies of indigestion after a hearty meal of eel, not from a recurrence of the disease.

Eels are among the greediest and most active of fishes, though like many other fresh-water fishes they are much more active by night than by day. They not only devour anything living that is small enough for them to catch, but also delight to feed upon any kind of dead or even putrid carcass.

From time immemorial students have puzzled over the time and place where eels spawned. Every spring vast hordes of tiny young eels ascended the rivers, making their way over waterfalls, dams, and even crawling through damp grass to places not to be reached by swimming. Here, far from the sea, they reached a large size but no sexual development followed. In the fall large eels were observed going downstream, these being the ones caught in the eel pots that the fishermen set in the estuaries. All sorts of theories and speculations were advanced to account for the mystery, and it was not until 1707 that the female eel was first made known, while the male was not discovered until 1873. Many more years of patient investigation were required before the life history of the European and American eels was known, while that of the Indo-Pacific eels is still almost a total blank.

When the European eels attain proper maturity they make their way downstream to salt water. Continuing westward they ultimately reach the edge of the continental shelf and drop off into the depths, still westward bound. On arriving in salt water their gonads develop rapidly, and by the time they reach the western Atlantic they are ready to reproduce. In a region about  $27^{\circ}$  north and  $60^{\circ}$  west, southwest of Bermuda, and at a depth of about 500 fathoms, the eggs are laid and fertilized, the adults then perishing. Our knowledge of the location of the spawning grounds is due to the investigations of Dr. Johannes Schmidt, of Copenhagen. The American eel has its spawning places in a zone west and south of the European, but overlapping. The larvae of both species appear to pass their earliest stages together, but when they are about 3 centimeters long one species turns toward Europe, the other toward North America.

When hatched the larvæ, in common with those of some other eels and most isospondylous fishes, are delicate, ribbon-shaped creatures of glasslike transparency and with disproportionately small heads. In this stage they are known as Leptocephali, many having been originally described under this name before their true relationship was recognized.

Making their way to the surface, they drift toward the coast of Europe or America, as the case may be, reaching the former at the end of the second year, the latter at the end of the first. Through the compacting of their tissues they become shorter, lose their ribbon shape, and become eel-like, the European species entering the mouths of rivers as small, unpigmented eels about three years after their parents entered the sea. Here they darken to the characteristic color and begin ascending the rivers, the females going up to the headwaters, sometimes 3,200 kilometers or more from the sea. The males, so far as known, do not go beyond the brackish reaches of river mouths, and mostly remain in salt-water lagoons and bays along the coast.

The young eels sometimes ascend streams near the sea in incredible numbers, so that it is impossible to dip a bucket of water without taking a large number. All ordinary obstacles are easily passed, and they reach lakes having an elevation of 915 meters above the sea. Spencer F. Baird found hundreds of wagonloads of young eels crawling over the rocks and squirming in the whirlpools at the foot of Niagara Falls, which of course they could not surmount.

From specimens collected by the Siboga Expedition under the direction of Dr. Max Weber, we may be certain that the Indo-Pacific species of *Anguilla* have a similar life history, as many Leptocephali in different stages of development were obtained, some of which Weber believes to belong to *Anguilla*. One of these, having a length of 115 millimeters, was collected in the Sulu Sea at a depth of 1,270 meters. So far as I am aware, there are no data upon the breeding grounds of the *Anguillas* of Japan and the adjacent Asiatic coasts, or any of the Indo-Pacific species.

Four species of *Anguilla* are certainly known to occur in the Philippines, though their distribution is not determined, owing to lack of material. At least two species occur in the same localities, and it is probable that all of them will be found to occupy overlapping territory.

## Genus ANGUILLA Shaw

*Anguilla* SHAW, Gen. Zool. 4 (1804) 15.

Characters of the genus included above.

Key to the Philippine species of *Anguilla*.

- a<sup>1</sup>.* Origin of dorsal much in advance of anus.
- b<sup>1</sup>.* A toothless groove divides the bands of teeth lengthwise in both upper and lower jaws..... *A. mauritiana*.
- b<sup>2</sup>.* Bands of teeth in both jaws without a toothless groove.
- A. celebesensis*.
- a<sup>2</sup>.* Origin of dorsal not far in advance of anus.
- c<sup>1</sup>.* Origin of dorsal above or slightly before anus; gape extending to hind border of eye or beyond..... *A. australis*.
- c<sup>2</sup>.* Origin of dorsal above or behind anus; gape not reaching rear margin of eye..... *A. spengeli*.

*Anguilla mauritiana* Bennett.

*Anguilla mauritiana* BENNETT, Proc. Comm. Zool. London (1831) 128; EVERMANN and SEALE, Bull. U. S. Bur. Fisheries 26 (1906) (1907) 56; JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 237; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 239; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 245, figs. 100 and 102.

*Muræna maculata* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 9, pl. 1, fig. 2.

? *Muræna manillensis* (?) BLEEKER, Atlas Ichth. Muræn. 4 (1864) 10, pl. 44, fig. 2.

Depth 12 to more than 17 in length (14 to 21 according to Weber and Beaufort), head 6 to 7.3 (7 to 7.75, Weber and Beaufort), and 1.6 to 2 in trunk; eyes rather small, 8.6 to 14 in head, 1.7 to 3 in interorbital space, and 1½ to 3 in the broad, blunt snout, the latter 4 to 5.4 in head; breadth of snout at its base usually greater than its length; the large mouth reaches beyond posterior margin of eye (in one specimen to the posterior border) and is 2.6 to 3.25 in head; lips noticeably thick and fleshy; length of head usually more than or may be equal to distance from gill openings to origin of dorsal, which is always well forward; distance from origin of dorsal to anus equal to or greater than distance from head to dorsal origin, and in small specimens it may be nearly twice as much; pectorals with sixteen to eighteen rays and 2.3 to 3.4 in head; tail exceeds length of head and trunk together by a distance varying from one-half the length of head to one and one-third times head in small specimens.

Maxillary teeth form a broad band, longitudinally divided by a toothless groove; intermaxillary and vomerine teeth form

a broad band separated from those of maxillaries on either side by a concave toothless groove; posteriorly they taper rapidly and do not extend as far back as maxillary teeth; teeth of mandibles separated at symphysis by a groove, and each band is likewise divided lengthwise by a rather wide toothless groove; the series of teeth in both upper and lower jaws much reduced posteriorly, the series inside groove tapering into a single row.

The color in life varies considerably, ranging from olive green mottled with dark brown to clay yellow variegated with darker; the commonest color is probably gray-brown marbled and clouded with dark brown, olive, or blackish; the belly and throat paler brown, yellow, or even white. The color in alcohol is similar but paler, while the marblings may be less evident.

This species is common in the Philippines, specimens being recorded from Calayan, north of Luzon, to Jolo. In northern Luzon they occur in mountain streams up to an altitude of more than 1,530 meters. The profile and proportions change greatly with age, old specimens probably being the bulkiest and largest of all eels, though exceeded in length by *Evenchelys macrurus*, and perhaps by *Muraenesox talabon*. In the Manila markets one may see living specimens from Laguna de Bay up to a length of 2 meters and a circumference of about 460 millimeters.

I have examined specimens from Pinacanauan River, Cagayan Province, Ilocos Sur, Bontoc, Mountain Province, the mountains of Zambales near Iba, Laguna de Bay, and Bicol River, Luzon; from Cabalian in Leyte; from the Pulangi, Mindanao; and from Sibuyan, Masbate, Polillo, and Jolo Islands. Jordan and Richardson listed it from Calayan and Mindoro, Evermann and Seale from Tarlac, Seale and Bean from Zamboanga, Bleeker from Manila, and Günther from the "Philippines." My smallest specimen is 190 millimeters long.

This eel is in great favor among the Tagalogs, and commands very high prices, 8, 10, or even 15 pesos sometimes being paid for a single fish. It is known from Natal and the east coast of Africa, the islands of the Indian Ocean and the East Indies, north to Formosa, southeast to South Australia, and throughout the South Pacific to the Society Islands.

*Anguilla manillensis* Bleeker is said to have the mouth reaching hardly beyond the middle of the eye and to show some less-important differences, but I have not seen it and doubt its specific identity. In all the numerous specimens thus far examined by me the mouth has reached beyond the eye except in the small specimens (190 millimeters long) from Jolo, where it came only to the posterior margin of the eye.

*Anguilla celebesensis* Kaup.

*Anguilla celebesensis* KAUP, Cat. Apod. Fishes Brit. Mus. (1856) 42, fig. 31; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 247, figs. 99 and 101.

*Anguilla megastoma* KAUP, Cat. Apod. Fishes Brit. Mus. (1856) 50, fig. 42; JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 192.

*Anguilla amboinensis* PETERS, Monatsber. Akad. Wiss. Berlin (1866) 523.

*Anguilla aneitensis* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 34, Fische d. Südsee 3 (1910) 391.

Depth 14 in length, 1.83 in head; the latter 7.68 in length and 2.1 in trunk; head and trunk together equal to two-thirds length of tail, the trunk alone 2.28 in tail; eye, interorbital space, and breadth of base of snout equal; snout 4.78 in head, gape 2.75, pectoral fin 2.6. Mouth extends an eye diameter beyond eye. Distance from head to origin of dorsal 1.38 times the length of head; from origin of dorsal to anus eight-elevenths of head.

Teeth very numerous, pointed, uniform in size, depressible, directed backward; intermaxillary and vomerine teeth form a



FIG. 1. *Anguilla celebesensis* Kaup, denticulation; a, vomer and maxillaries; b, mandibles. After Weber and Beaufort.

bands in mandible separated by a toothless groove at apex of jaws.

Body stout, head flat and depressed, lips very thick, reflexed, with large pores on lips and snout; distance between origin of dorsal and origin of anal almost equal to head.

Color in alcohol blackish to grayish above, the sides more or less mottled with yellowish, becoming pale yellow on chin, throat, and belly; underside of tail and anal fin likewise mottled; anal and dorsal fins with pale or yellowish margins. In living specimens pectoral dusky, pale margined, the yellow much more noticeable, and the general color paler.

Here described from a specimen from Lake Lanao, having the following dimensions: Length, 845 millimeters; depth, 60; head, 110; trunk, 232; tail, 512; eye, 9; snout, 23; gape, 40; pectoral,

band which is slightly wider at first than the maxillary bands and tapers very gradually backward until it is about two-thirds as wide; maxillary bands separated from vomerine band by toothless grooves; they taper very slightly and extend as far back as the vomerine band does;

42; interorbital space, 23. I have also examined a second specimen from Lake Lanao, having a length of 795 millimeters.

This species is common in Lake Lanao and has been recorded by Casto de Elera from Manila. Lake Lanao is a large fresh-water lake in northern Mindanao, having an area of 176 square kilometers, and lies at an elevation of slightly more than 670 meters. It is very deep along the southern shore, the military finding a depth of over 150 fathoms near Bayong when laying the cable which crosses the lake. The only outlet is through the Agus, a small river at the northern end of the lake, only about 30 kilometers in length, and over a large part of its course a continuous rapid. Near the coast it takes a leap of 58 meters, the Maria Cristina Falls. As fresh-water eels spawn only in the ocean, this presents a very interesting problem. It is evidently impossible for any fish either to ascend or to descend these falls directly, but a recent visit to Lanao offers a reasonable explanation of the puzzle.

Eels occur in such isolated lakes as Nunuñgan, which is entirely surrounded by mountains but which has a subterranean outlet. Through this channel eels and small Cyprinidæ come and go. The whole volcanic plateau of Lanao has many such subterranean water courses.

An inspection of Maria Cristina Falls shows that the lower gorge of the Agus terminates in a box cañon, the falls being caused by the river leaping from the upper valley over the precipice. On the south side of the gorge, perhaps a third of the way above the torrent at the bottom, is a layer of rock which is evidently honeycombed with water passages. From this layer issue many small cascades and spurting streams which tumble down the talus blocks into the boiling river below. Owing to the overhanging nature of the cliffs on the north side, where only one can safely view the falls, it is impossible for me to say whether there is a similar layer of cavernous water-bearing rock on that side or not. There can be no doubt that very slender young eels crawl up the wet talus, enter the crevices in the water-carrying layer of rock, and work their way up against the subterranean streamlets until they reach the river well above the falls.

The relative proportions of length, depth, head, eyes, interorbital space, snout, and mouth vary considerably with age and stoutness, large specimens being relatively more robust, with smaller eyes and larger mouth. According to Weber and Beau-

fort the eyes vary from 6.6 (in young) to 13.5 in the head, 1.3 to 2.3 in the interorbital space, and 1.1 to 2.5 in the snout; the gape 2.4 to 4 in the head. There is also considerable variation in the number of teeth, the length and shape of the vomerine band, and the degree to which the dental bands taper. The location of the origin of the dorsal likewise varies, but it is always nearer the anus than the gill opening and the distance between the origin of the dorsal and of the anal is about equal to the length of the head or a very little more or less.

The synonymy cited above does not include all grouped under *Anguilla celebesensis* by Weber and Beaufort, inasmuch as the original descriptions are often incomplete, contradictory, and confusing, and while their arrangement may be correct the type material should be examined in order to settle the matter. My specimen is much more robust and has a flatter profile than the figure given by Weber and Beaufort, but it agrees almost exactly in dentition with their figure 101.

This species is abundant in Borneo, Celebes, New Guinea, and the smaller islands grouped about them, and in the South Sea Islands, where it reaches a gigantic size. It is a food fish of considerable importance wherever found.

***Anguilla australis* Richardson.**

*Anguilla australis* RICHARDSON, Proc. Zool. Soc. London (1841) 22.  
*Muræna sidat* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 10, pl. 3, fig. 3.  
*Muræna moa* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 11, pl. 4, fig. 1.  
*Muræna australis* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 12, pl. 7, fig. 1.

*Muræna halmaherensis* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 12, pl. 6, fig. 4.

*Anguilla bicolor* and *virescens* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 35.

*Anguilla sidat* and *australis* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 36; JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 192.

*Anguilla bicolor* DAY, Fishes of India (1878-88) 660, pl. 148, fig. 2.

Depth 13.6 to 17 in length, head 7.2 to 8.5 and 2 to 2.25 in trunk; eye small, 11 to 11.7 in head in my specimens (8 to 10 according to Weber and Beaufort), 2 in snout (1.2 to 2.1, Weber and Beaufort), and 2.25 in interorbital space (1.5 to 2.8, Weber and Beaufort); snout a sixth or seventh wider at its base than its length, which is 5.5 in head (6 to 8, Weber and Beaufort); mouth reaches beyond eye, its gape from 3.28 to 4 in length of head; pectorals with fourteen rays, 3.4 in head (2 $\frac{1}{2}$  to 3.5, Weber and Beaufort); tail exceeds head and trunk

together by 1.28 to 1.37 times the length of head, or 28.3 to 31.5 per cent of its own length; dorsal begins exactly over anus in my specimens, though usually it is inserted a little before vent and anal begins a very short distance behind it.

Upper jaw has a continuous many-rowed band of small teeth, which tapers posteriorly and unites anteriorly with the vomerine teeth without a delimiting groove at junction; teeth on vomer in an elongate paddle- or pear-shaped band which extends as far back as do the maxillary bands; bands of teeth in lower jaw broadest anteriorly, tapering posteriorly; they are almost separated at the symphysis by a distinct groove, being united and continuous only at the extreme anterior portion.

Specimens in alcohol uniform dark brown above, merging into very pale brown beneath; anal pale or light yellowish except near tip of tail where it is dark; in life all the fins were evidently uniform in coloration with back and sides.

Here described from two specimens, 515 and 600 millimeters in length, collected by Mr. Alejo Arce at Lake Bato, Camarines. There are two stuffed specimens, collected at Cavite, in the museum of the University of Santo Tomas. There is also a specimen, 320 millimeters long, from Guam in the Bureau of Science collection. This specimen has the eye contained but  $7\frac{1}{2}$  times in the head, and is quite different in several respects though it undoubtedly belongs here. The undersurface and all except the posterior fifth of the anal are clear uniform pale yellowish.

This eel reaches a length of 1 meter and occurs from Natal and the east coast of Africa to the coasts of India, the East Indies, Tasmania, New Zealand, and the islands of the South Pacific.

*Anguilla spengeli* M. Weber. Plate 1, fig. 1.

*Anguilla malgumora* SCHLEGEL, Mus. Lugd. Bat., nec Kaup.

*Anguilla mowa* BLEEKER, Verh. Bat. Gen. 25 (1853) Muræn. 16, pro parte.

*Muræna malgumora* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 11, pl. 2, fig. 1, nec Kaup.

*Anguilla malgumora* KNER, Novara Exp. 1 Fische (1865-67) 367.

*Anguilla spengeli* MAX WEBER, Zool. Jahrb. Suppl. 15, 1 (1912) 591; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 249.

Depth 12.87 in length, head 7, and 2 in trunk; tail exceeds rest of animal by a little less than the length of head (96.5 per cent) or 24.2 per cent of its own length; jaws equal, lips comparatively thin; eye moderately large, 9.7 in head, 2 in the broad,

triangular, rather sharp snout, and  $2\frac{1}{3}$  in the interorbital space; mouth of medium size, its gape 3.6 in head; as is often the case in eels the mouth is asymmetrical, on one side not extending beyond the pupil, on the other not reaching the rear margin of the eye; pectorals two-thirds as broad as their length, which is 2.75 in head; origin of dorsal behind anus and farther back than origin of anal; teeth of nearly uniform size, those of upper jaw forming a broad continuous band which tapers but little posteriorly; it is continuous around anterior outer portion of intermaxillary plate and partially separated by two distinct lateral grooves on inner anterior side from the broad vomerine band, which tapers but little posteriorly and does not extend backward as far as do the maxillary teeth; bands in lower jaw partially separated by a groove which does not reach to anterior margin so that they are continuous there; posteriorly they taper gradually to about half their greatest anterior breadth.

Color in life uniform very dark olive brown, slightly paler to yellowish on belly; pectorals, dorsal, and caudal blackish; color in alcohol similar but paler, becoming brown laterally to yellowish under head and belly; anal with a pale margin except near caudal.

Here described from a specimen obtained by me in Cotabato River, Mindanao, not far from its mouth. In the position of the dorsal it resembles *Anguilla dussumieri* Kaup, but does not agree with it otherwise as far as can be judged from Kaup's figure and unsatisfactory description. This specimen differs also from any other I have examined in the greater development of its caudal fin and the contiguous confluent portions of the dorsal and anal. Length, 615 millimeters; head, 88; trunk, 177; tail, 350; depth, 40; eye, 9; snout, 18; gape, 24; origin of dorsal, behind anus, 15.

A rare East Indian species, also recorded by Kner from Australia. According to Bleeker the eye is contained from 6 to 6.5 times in the head; the difference in my specimens may be due to their much larger size since as a rule the eyes are proportionately larger in young specimens.

#### LEPTOCEPHALIDÆ

This family includes scaleless eels having the tongue largely free in front, the body elongate, with lateral line and well-developed pectoral and vertical fins, the latter confluent around the tail; the posterior nostrils distant from the upper lip and near the front of the eye; the lower jaw more or less included.

These eels are found at moderate depths in most warm and temperate seas and estuaries, and also enter brackish and fresh water. All the species are plainly colored, grayish, dusky, or brownish above and pale or silvery beneath.

Like the *Anguillidæ* and some isospondylyous fishes, the conger eels undergo metamorphosis. When hatched they are strange-looking, elongate, transparent, ribbonlike animals with minute head and very tiny mouth. With advancing age the body becomes smaller as the tissues are compacted until after a year or so they assume the general form of the adult.

*Key to the genera of Leptocephalidæ.*

*a<sup>1</sup>.* Anterior nostrils in a tube.

*b<sup>1</sup>.* Origin of dorsal over or behind middle of pectorals.... *Leptocephalus*.

*b<sup>2</sup>.* Origin of dorsal above, before, or slightly behind base of pectorals.

*Ariosoma*.

*a<sup>2</sup>.* Anterior nostrils not tubulate. Dorsal beginning over or behind base of pectorals; tail strongly tapering, very long, and whiplike.

*Uroconger*.

**Genus LEPTOCEPHALUS Scopoli**

*Leptocephalus* SCOPOLI, Int. Hist. Nat. (1777) 453.

**CONGER EELS**

Large and powerful marine eels, which strongly resemble *Anguilla* in general appearance but lack scales, the elongate body becoming much compressed posteriorly. Vertical fins well developed, confluent with caudal, origin of dorsal above the well-developed pectorals. Head of moderate size, depressed, often flat above eyes, pointed; eye large, covered by skin; posterior nostrils opposite upper or middle part of eye, anterior nostrils in short tubes near tip of projecting snout; mouth extending to middle of eye or beyond, lips thick and large; tongue free. Teeth small, those in outer series in both jaws equal, compressed, and close-set, forming a cutting edge; the inner series incomplete or partially developed or even absent, of small conical teeth; teeth on vomer arranged in a short conical band, the point of which is directed backward; no canines. Lateral line present. Gill openings large, extending from pectorals downward. The skeleton differs much from that of *Anguilla*; vertebræ about 56 + 100.

This genus includes the well-known and almost cosmopolitan conger eel and a few closely related species. Some representative of the genus is found in nearly all temperate and tropical seas. I have been unable to learn of any distinctive names

applied to the species of this group by any of the Filipinos with the exception of the Visayans, who call them *obud* or *obod*.

I have described one species of wide distribution in the Indian and Pacific Oceans, and one larval form known only from the Philippines.

**Leptocephalus cinereus (Rüppell).**

*Conger cinereus* RÜPPELL, Atlas Reise Nördl. Afrika, Fische des Rothen Meers (1828) 115, pl. 29, fig. 1; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 258, figs. 5, 107, and 108.

*Conger marginatus* VALENCIENNES in Eydoux and Souleyet, Voyage Bonite, Poiss. (1841) 201, pl. 9, fig. 1.

*Leptocephalus marginatus* JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 76.

*Conger noordzieki* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 26, pl. 28, fig. 2.

Head and trunk 2 in tail; head 8.68 in total length and 1.88 in trunk; greatest depth 16.44 in total length; mouth 2.4, snout 3.6 in head; eye longer than high, its length a trifle more than one-third that of jaw and equal to interorbital space; pectoral 2.88 in head.

Body elongate, rounded, becoming strongly compressed and tapering on tail; head long, pointed anteriorly but sides bulging strongly just behind eye; snout depressed, flattened above, and projecting beyond lower jaw; eye large, elliptical; mouth moderate, reaching not quite as far as hinder margin of eye, lips broad, thick, fleshy flaps; anterior nostrils near tip of snout, in short tubes which point downward; posterior nostrils immediately in front of eye and slightly below its upper margin; pectoral at upper angle of large gill openings; origin of dorsal just behind middle of pectoral.

Color dark grayish brown above, the undersurface pale to whitish, much paler anteriorly; a blackish streak from forward margin of eye to behind angle of mouth; dorsal and anal pale, becoming dark far back on tail, their free margin with a black band, edged with white; pectorals with a conspicuous black blotch.

The description above is from a specimen 625 millimeters long, purchased in the market at Jolo. Its other measurements are as follows: Head, 72 millimeters; tail, 417; depth, 38; upper jaw, 30; snout, 20; eye and interorbital space, each 11.

An unlabeled specimen in the Bureau of Science collection has the following dimensions: Length, 610 millimeters; head,

78; tail, 390; depth, 34. I have also collected two specimens at Dumaguete, Oriental Negros, with lengths of 550 and 320 millimeters, respectively.

Authors state that the depth of this eel is contained from 16 to 20 times in the total length, and the head from 8 to 9 times; the tail is usually less than twice the length of head and trunk.

According to Günther this eel reaches a length of 1.25 to 1.6 meters. It occurs throughout the Indo-Pacific region from the Red Sea, Madagascar, and the east coast of Africa to the Hawaiian and Samoan Islands. It is esteemed as food in the Sulu Archipelago.

It is with some doubt that I follow Weber and Beaufort in adopting Rüppell's name in preference to *Conger marginatus* of Valenciennes. Rüppell's description might apply but his figure is far from convincing and resembles but little the specimens I have seen from Hawaii, Samoa, and the Philippines.

#### ***Leptocephalus brevicaudus* Peters.**

*Leptocephalus (Diaphanichthys) brevicaudus* PETERS, Monatsber. Akad. Wiss. Berlin (1864) (1865) 399.

Körper ganz platt zusammengedrückt, die Profillinie der Bauchseite convex, die des Rückens fast gerade. Schnauze sehr spitz, vor dem Auge convex, ein wenig kürzer als der Augendurchmesser; Maul bis unter die Mitte des Auges gespalten, jederseits oben und unten mit 8 geraden spitzen, und hinten im Oberkiefer mit noch einigen kleineren spitzen Zähnen bewaffnet. Die hinteren Nasenlöcher liegen auf der Schnauze, den Augen etwas näher als der Schnauzenspitze. Die Augen liegen in der Mitte des Kopfes. Kiemenspalten sehr eng. Keine Brustflossen, keine Rücken- und Afterflosse, indem das Körperende nur von der Schwanzflosse umfasst wird, welche sich oben und unten auf 1.5 Millimeter ausdehnt. Die untere Körperhälfte ist in der Körpermitte reichlich 1/3 höher als die obere Hälfte. Der farblose Körper zeigt längs der Rückenfirste sowie jederseits neben dem Darmcanal eine Reihe schwarzer Pünktchen und unter der Chorda, dem Anfange der ventralen Muskelabtheilungen entsprechend, feine schiefen Linien von derselben Farbe.

Totalänge 88 mm.; Kopf 35 mm.; von der Schnauzenspitze bis zum hinteren Augenrande, 2 mm.; vom After bis Schwanzende (ohne Flosse), 33 mm.; Höhe der Körpermitte, 13 mm.

This larval eel is known only from eight examples caught by Doctor Jagor in the open sea between Masbate and Luzon. The smallest specimens had a length of but 60 millimeters, but all had the same structure and proportions.

In the present state of our knowledge we cannot identify these larvæ with any known adult species.

## Genus ARIOSOMA Swainson

*Ariosoma* SWAINSON, The Natural History of Fishes, Amphibians, and Reptiles or Monocardian Animals 2 (1839) 194.

*Congrellus* OGILBY, Proc. Linn. Soc. New South Wales (1898).

A genus comprising many small congers distinguished by the more forward origin of the dorsal and the greater development of large mucus cavities in the front part of the head; snout usually prominent; posterior nostrils opposite middle of eye, the anterior ones near tip of snout and tubulate; mouth wide, not reaching hinder margin of eye; teeth acute, in bands or in a few series in jaws, not forming a cutting edge; vomer with a short patch of larger teeth or a patch of small teeth tapering into a rather long and gradually larger series; teeth on intermaxillary plate small or forming a patch of larger teeth forward of mouth; gill openings wide apart, nearly vertical, beginning below upper margin of base of pectorals, much narrower than their interspace or the diameter of eye.

*Ariosoma* Swainson must take precedence over *Congrellus* Ogilby.

*Ariosoma obud* \* sp. nov. Plate 1, fig. 2.

Depth 3.1 in head, 18.4 in length; head 5.9 in length, 1.55 in trunk; head and trunk together about  $2\frac{1}{3}$  in total length and three-fourths as long as tail; eye 4.42 in head, and almost as long as snout; gape extends to a point beneath forward margin of eye and is  $3\frac{7}{8}$  in head; pectorals 2.8 in head.

Teeth very small and needlelike, the maxillary bands of about four rows at forward end, narrowing down at rear to two rows; a dense mass of slightly larger teeth covers intermaxillary plate, filling in all space between the forward ends of maxillaries, and merges into those of vomer which begin as three poorly defined rows and soon become a single series, five-sevenths as long as maxillary bands; teeth of the mandibles in four rows at forward end, becoming a single row posteriorly.

An elongate little eel with subcylindrical body and compressed tail; dorsal profile convex, snout projecting slightly, lower jaws weak; eye large, circular; lips thick and recurved; muciferous cavities and pores numerous and prominent on jaws and around eyes; those of lower jaw continuous with lateral line, which originates on nape; forty pores in lateral line forward of anus;

\* From *obud*, a Visayan name for eels belonging to the Leptocephalidæ.

origin of dorsal over base of pectoral, highest near origin, where it is equal to one-half the depth of body, becoming lower posteriorly; gill openings much narrower than their interspace.

Color pale brownish gray, dorsal surface much darker than the part below lateral line; interspace between eyes blackish; body almost everywhere thinly sprinkled with minute dark dots, which extend to the hyaline fins, where they form indications of a black margin.

The above description is from a specimen obtained at Marinduque Island, with dimensions as follows: Length, 184 millimeters; head, 31; trunk, 48; tail, 105; depth, 10; eye, 7; snout, 7.5; gape, 8; pectoral, 11.

This is very close to *Congrellus anago* as described by Weber and Beaufort<sup>5</sup> but differs in several particulars, especially in the dentition, as may be seen by comparing the figure given with those just cited. Beyond question other species of the genus occur here, but as yet they have not been collected.

#### Genus UROCONGER Kaup

*Uroconger* KAUP, Cat. Apod. Fishes Brit. Mus. (1856) 110; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 264.

Small elongated eels with a subcylindrical body and a very long and tapering whiplike tail which becomes strongly compressed laterally and is at least twice as long as trunk; pectorals well developed; dorsal beginning approximately over base of pectorals and confluent with caudal and anal; head conical, as deep as or deeper than body, the forward portion depressed, and the blunt snout projecting beyond lower jaw; eye moderately large, covered by skin; anterior nostrils near apex of snout, without tubules; posterior nostrils large slits near to and in front of eyes; mouth of medium size, extending a little beyond middle of eye; lips of moderate size, upper with a row of short slitlike mucus pores; tongue free; teeth needlelike, small but quite unequal in size, those of upper jaw in two rows, in lower jaw in two complete rows with a third very short inner row; teeth on vomer small, in one or two rows, sometimes with a few larger caninelike teeth in front; those on intermaxillary plate in two irregular series, eight or ten in number; some of them, especially the outer ones, may be enlarged; lateral line present; gill openings large, situated vertically before and below base of pectorals.

<sup>5</sup> Fishes Indo-Austr. Arch. 3 (1916) 262, figs. 109 and 111.

One East Indian species of shallow waters from Arabia to China, and two deep-sea forms from the Atlantic, Pacific, and Indian Oceans.

Jordan states in his recent work on the genera of fishes that this name is of doubtful validity.

***Uroconger lepturus* (Richardson).** Plate 1, fig. 3.

*Congrus lepturus* RICHARDSON, Zool. Voyage Sulphur (1844-45) 106, pl. 56, figs. 1-6; Voyage Erebus and Terror, Fishes (1844) 109.

*Uroconger lepturus* KAUP, Cat. Apod. Fishes Brit. Mus. (1856) 110; BLEEKER, Atlas Ichth. Muræn. 4 (1864) 29, pl. 5, fig. 1; DAY, Fishes of India (1878-1888) 661, pl. 170, fig. 1; JORDAN and SEALE, Bull. U. S. Bur. Fisheries 26 (1906) (1907) 6; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 265, figs. 113, 114.

Depth 20 to about 26 in total length; head 7 to 9 in length and 1.5 to 1.68 in trunk; head and trunk together  $2\frac{1}{2}$  in tail, trunk alone 3.4; eye 5.5 to more than 7 in head, snout 3.8 to 4; mouth extends about to a perpendicular from rear margin of pupil of eye, 2.7 in head; pectorals 3.5 to about 4 in head.

A small blunt-headed eel with subcylindrical trunk and exceedingly elongate, slender, and laterally compressed tail which tapers to a point; the broad rounded snout projects slightly beyond lower jaw; dorsal begins above base of pectorals, its height equal to or a little more than half the depth of body; intermaxillary teeth in two transverse rows of four each, behind which are two pairs of smaller teeth and a single row of very small teeth on vomer which may become double posteriorly; lateral line prominent, beginning on nape.

Color uniform brown, thickly dotted with minute dark specks except on sides and underpart of head where it is very pale; vertical fins profusely dotted with dark specks and edged with black.

The only specimen in the Bureau of Science collection was obtained in the Manila market in 1907. It has lost about 5 millimeters from the tip of the tail. Its present dimensions are as follows: Length, 210 millimeters; head, 25; trunk, 42; tail, 143; depth, 8+; eye, 3.5; snout, 6.5; gape, 9; pectoral, 7.

There is a fine specimen 360 millimeters long from Mindoro in the museum of the University of Santo Tomas, and a specimen 12.5 inches long was noted from Manila by Jordan and Seale.

This very distinct little eel is of no economic importance apparently, being neither abundant nor large enough to rank as a food fish. It was originally described from the coast of

China and is found in shallow waters south and westward from Hongkong and Manila to the Sea of Oman, on the coast of Arabia.

As this paper goes to press I am in receipt of a specimen, 192 millimeters long, obtained at Luboc Beach, Lapaz, Iloilo Province, by Mr. Angel Villanueva, of the College of Agriculture, Los Baños.

### MURÆNESOCIDÆ

Scaleless eels, often large and robust, the narrow tongue fastened to the floor of the mouth or only its tip free, the jaws elongate with strong teeth, the middle row on the vomer composed of large canines; gill openings rather wide; posterior nostrils not labial; pectoral, dorsal, and anal fins well developed, the last two confluent with the caudal.

Separated by Gill and given family rank on the basis of the skeletal differences. A small family, resembling the Leptocephalidæ in habits and appearance. Most of the genera are American.

#### Genus *MURÆNESOX* McClelland

*Murænesox* McCLELLAND, Calcutta Journ. Nat. Hist. 4 (1843) 408.

The robust elongate body is subcylindrical, becoming compressed posteriorly; origin of dorsal above or slightly in advance of gill openings; head elongate, mouth large and extending well beyond eyes, with prominent, conical upper jaw, tip elongated, rounded, somewhat enlarged, and separated by a notch from rest of snout; anterior nostrils behind notch of snout and with a short tube; posterior nostrils in front of middle of eye, but at some distance from it; tongue adnate; maxillary teeth conical, in several rows, partly separated by a toothless interspace; teeth of mandible conical, in several rows, the outer of which may point outward, and the anterior teeth enlarged canines; vomer with several long series of teeth, the middle one of strong conical or compressed canines; gill openings rather wide, beginning opposite upper margin of base of pectorals, and separated from each other by a narrow interspace; lateral line conspicuous; anal opening in anterior half of body.

Large congerlike eels, important as food; found in all warm seas and notable for the large, strong teeth on vomer. We have two of the three East Indian species. The Filipinos do not distinguish these eels very clearly, the Tagalogs sometimes calling them *palos* or *pindangá*, the Visayans *obud*, *ubod*, or *palos*,

while the Sambali seem to have but the one word, *taleric*, which they apply to eels of the most diverse appearance.

*Key to the species of Murænesox.*

- a<sup>1</sup>.* Median canines with distinct basal lobes both front and back; outer row of teeth in mandibles erect..... *M. cinereus*.
- a<sup>2</sup>.* Median canines with never more than an indication of basal lobes; at least part of outer row of mandibular teeth pointed outward. *M. talabon.*

*Murænesox cinereus* (Forskål). Plate 10, fig. 1.

*Muræna cinerea* FORSKÅL, Descript. Anim. (1775) pp. X, 22.

*Murænesox cinereus* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 46; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 253, fig. 254.

*Murænesox bagio* KAUP, Cat. Apod. Fishes Brit. Mus. (1856) 116, pl. 14, fig. 73; BLEEKER, Atlas Ichth. Muræn. 4 (1864) 24, pl. 26, fig. 2.

*Murænesox singapurensis* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 25, pl. 7, fig. 2.

Depth 17 to 22 in total length (in our specimens about 19.5 and 21.5), the strongly compressed head 6 to 7; the large elongate eye 8 to 10 in head and 2 to 4 in snout; mouth very large, about  $2\frac{1}{2}$  times in head; teeth in upper jaw in three rows, those in outer row very small, second row much larger, and inner row curved and separated by a toothless area from the other two; intermaxillary plate with five large canines (eight or ten, Weber and Beaufort), followed by a row extending down vomer composed of compressed canine teeth with a basal lobe in front and behind, the posterior teeth very large; a row of much smaller teeth on each side of median row; in some specimens they are so small as to be barely visible; in lower jaw an outer row of small, erect teeth, a middle row of large, compressed teeth, and posteriorly a partial or irregular row of small teeth; the middle row of each side ends anteriorly in one or two large canines, around which the outer row is continued by five to seven large teeth; origin of dorsal in advance of base of pectoral or even before gill opening; pectorals dusky to blackish, pointed, and contained from 2.2 to 3 times in head; height of dorsal about 1.5 in body depth; silvery or ashy gray, sometimes with a slight tinge of golden yellow along sides; vertical fins pale or yellowish, with broad black or brownish black margins and black caudal.

Here described from two specimens from the Manila market, measuring 400 and 433 millimeters in length. The Bureau of

Science collection also has six specimens from Alaminos, Pangasinan; one from Agno River, Pangasinan; one from Bancal River near Iba, Zambales; one from Calabang, Camarines; one from Tacloban, Leyte; two from Hongkong; and two from Sandakan, Borneo. These range in length from 265 to 650 millimeters.

Through the kindness of Prof. A. L. Day, of the University of the Philippines, I have examined some specimens from Cavite. The largest of these, with a length of 455 millimeters, is a female ready to spawn. Her body is markedly enlarged by the ripe ovaries, which extend for some distance behind as well as a long way before the anal opening. Unfortunately the date of collection is not known. This eel has also been recorded from the Philippines by both Richardson and Günther and from Manila by Jordan and Seale and by Jordan and Richardson.

This very large eel is abundant in the Manila markets, where specimens 2 meters in length are occasionally seen. Though originally described from the Red Sea it is very widely distributed and occurs from the east coast of Africa throughout the Indian Ocean and in the Pacific from Japan to Australia and the South Sea Islands; it is everywhere esteemed for food. Though primarily a marine species it occurs plentifully in the mouths of rivers and up them as far as the tides are felt.

*Murænesox talabon* (Cantor).

*Conger talabon* CANTOR, Journ. Asiatic. Soc. Bengal 18 (1850) 1294.

*Murænesox talabon* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 22, pl. 8, fig. 2; GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 45; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 255, figs. 103 and 105.

*Murænesox talabon* DAY, Fishes of India (1878) 661, pl. 168, fig. 5.

Depth 17.8, head 6.56 in total length; head 4+; head and trunk 1.64 in tail, which is 0.62 of the total length; eye 3 in snout and 11.3 in head; cleft of mouth 2.27 in head, pectoral a little more than 3.

*Measurements of two specimens of Murænesox talabon.*

	No. 9476.	No. 9495.		No. 9476.	No. 9495.
Length.	mm. 820	mm. 950	Eye.....	mm. 11	mm. 14.5
Depth.....	46	58	Snout.....	33	48
Head.....	125	155	Mouth.....	55	69
Trunk.....	185	219	Pectoral.....	40	49
Tail.....	510	576			

Teeth in upper jaw begin far behind snout, in three series, the outer one of minute teeth closely appressed against the much larger second row; inner row short, curved, and separated from outer row for most of its length by a wide interspace; intermaxillary plate with about six or eight canines around margin and a short row of smaller teeth in center; vomer with a central row of about eight or ten strong, sharp-pointed canines, without basal lobes, the posterior ones largest and roughened as if they might develop lobes, and two lateral rows of very small, irregular, and poorly developed teeth very close to the central row; teeth in mandibles in three rows, those of outer row small, closely set behind but apart, pointed, and turned more or less outward in first half of jaw; second row of very much larger and stronger, laterally compressed teeth, ending at front in four or five long, strong canines; inner row of minute teeth.

The general arrangement of the teeth is like that in Weber and Beaufort's figure, which does not agree with their text. The large teeth are subject to considerable variation, as in my specimens I can see that teeth have been broken out in some places and in others are only partly regrown.

The dorsal is very low in front and begins in advance of the gill opening; on the tail it is half or more than half as high as the body beneath; the anal is very low.

Trunk plump, rounded, becoming compressed on tail, which is greatly flattened posteriorly; snout sharp, very long and narrow.

Ashen gray to olive above, becoming darker on snout, paler on sides, and merging into white on belly, everywhere with a silvery sheen; belly and lower part of sides sprinkled thickly with dark dots; jaws and sides of trunk with a butter-yellow or golden tinge which extends over pectorals, these more or less dusky on inside; dorsal pale, with a yellowish cast, anal silvery whitish, each with a broad black margin; lateral line conspicuous, its origin below nape.

The larger of the two specimens cited above had a broad yellow-green band on the upper surface along the base of the dorsal; the sides were silvery with a golden luster on the head and body, this fading soon after death; the underside paler, becoming white on the throat and belly; the pectoral was pale lemon yellow, with a dusky blotch more or less evident on the inner side near the extremity.

A specimen seen in the Manila market was nearly 2 meters in length and had an exceedingly robust trunk, with a girth of about 375 millimeters.

The depth varies from 15 to 25 and the head is somewhat more or less than 6 times in the length; the eye is from 9 to 11.5 times in the head.

This large and powerful marine eel, which is said by Day to reach a length of 10 feet or more, occurs in the warm seas of the Orient and also enters brackish waters. It is frequently taken with *Muraenesox cinereus* in Manila Bay, though not in such numbers, and is not rare in the Manila markets, where it is highly prized for food.

Originally described in India, it is found in all the East Indies and north to the coast of southern China. The smaller of my specimens has the mesentery and body cavity infested with many small nematodes, concerning which nothing is known definitely. Similar worms may be observed in great numbers in various species of fish, a notable instance being the herring, abundant at times on the coast of California.

#### HETEROCONGRIDÆ

Greatly elongated scaleless eels, the trunk subcylindrical, with compressed, ribbonlike tail, nearly twice to more than twice as long as head and trunk together, not, as incorrectly stated by Weber and Beaufort, "nearly twice or more than twice in head and trunk;" dorsal and anal rather low, confluent with caudal; pectorals absent or minute; snout obtuse, very short, cleft of mouth oblique, not reaching eye or at most extending to a point below its front margin; lower jaw extending beyond upper; posterior nostrils in front and slightly below level of upper margin of eye; anterior nostrils very small, concealed; tongue free; teeth in jaws and on vomer small, acicular, arranged in bands; gill openings lateral narrow slits; lateral line present.

A rare family hitherto known from a single genus with one species in Amboina and one in the Canary Islands. The skeletal characters are unknown.

Diagnosis here altered from Weber and Beaufort,<sup>6</sup> to include a new Philippine genus and species.

##### *Key to the genera of Heterocongridæ.*

<i>a<sup>1</sup>. Pectorals absent .....</i>	<i>Heteroconger.</i>
<i>a<sup>2</sup>. Pectorals present .....</i>	<i>Tæniocconger.</i>

<sup>6</sup> Fishes Indo-Austral. Arch. 3 (1916) 271.

Genus TÆNIOCONGER<sup>7</sup> novum

This genus differs principally from *Heteroconger* Bleeker in having pectoral fins; they are very small but plainly evident; the mouth is also smaller than in *Heteroconger*; the vomerine teeth are much thicker and stronger than those of the jaws; the upper lip forms a loose flap or fold turned back over the upper jaw; there is a similar flap on the lower jaw but it is less-well developed.

Type, *Tænioconger chapmani* sp. nov.

*Tænioconger chapmani* sp. nov. Plate 3.

An excessively elongated and slender eel, depth 86.25 in length; the elongated subcylindrical trunk passes gradually into the flattened, ribbonlike tail which is  $2\frac{1}{2}$  times as long as head and trunk together; head small and short, its length a little more than 7 in trunk and a trifle more than 26.5 in total length, its greatest breadth  $3\frac{5}{7}$  in its own length; the obtuse blunt snout about 6.5 in length of head; mouth wholly anterior, very oblique, not extending to eye; lower jaw same length as snout and projecting like that of a bulldog; eye very large, its diameter about one-fifth the length of head; posterior nostrils in front of eyes, about on a level with their upper margin.

Teeth very small, pointed, subequal, closely set; upper jaw with three rows anteriorly, becoming reduced to two and finally at rear to a single row of larger, needlelike teeth; vomer with six rows anteriorly, forming a broad patch and tapering posteriorly to a single row; vomerine teeth two or three times as coarse as and also somewhat longer than those in bands on jaws; mandibles with four rows of teeth anteriorly, these reduced to two rows posteriorly.

Gill openings nearer back than belly and wider than base of the minute pectorals which lie directly behind them; pectorals 4 in greatest depth of body and 13 in length of head; height of dorsal one-fourth of depth of body, its origin less than half the height of body behind gill openings; anal begins immediately behind vent; origin of lateral line on nape; a row of pores on lower jaw and along throat as far back as a point beneath origin of lateral line; two pairs of pores on snout in front of posterior nostril and a line of large pores curving under and around each eye to top of head.

<sup>7</sup> *Tænioconger*, from *τανια*, a band; conger, an eel.

Here described from the type and only specimen, collected at Dumaguete about 1914, by the zoölogical department of Silliman Institute. The specimen was damaged by a thick fungal scum which covered the preservative in which the fish was kept, so that the eyes were destroyed and the lips damaged; the anterior nostrils were therefore not seen by me. The eyes were apparently covered by the skin in life. This singular eel is an unexpected addition to a little-known family, the only other East Indian representative having been described and figured by Bleeker from Amboina under the name of *Heteroconger polyzona*,<sup>8</sup> with a text figure.

The type and only specimen has the following dimensions: Length, 690 millimeters; head, 26; trunk, 184; tail, 480; greatest depth of body, 8; length of snout, 5; height of dorsal, 2; eye, 5.

Named for Dr. J. W. Chapman, professor of zoölogy in Silliman Institute, Dumaguete, Oriental Negros.

#### MYRIDÆ

This family is composed of scaleless, more or less wormlike eels, usually small and dull colored. Vertical fins confluent, while the pectorals may be well or poorly developed or altogether absent. Posterior nostrils usually near eyes in upper lip and covered by a valve or protruding flap; anterior nostrils in a short tube at margin of upper lip. Tongue more or less completely adnate; teeth small, in one or more series or bands. Gill openings small to very small. Anus in anterior half of length but far behind gill openings.

Fishes of the tropical and subtropical seas, living in coral reefs, on sandy coasts, or in the sea near them.

Represented in the Philippines by only one genus.

#### Genus MURÆNICHTHYS Bleeker

*Murænichthys* BLEEKER, Verh. Bat. Gen. 25 (1853) Muræna 71.

Very elongate and slender, scaleless, cylindrical, more or less wormlike eels, without pectoral fins, tail comprising more than half the total length, and with both nostrils on margin of upper lip, the anterior tubular, the posterior at base of a pendulous flap; snout projecting somewhat beyond lower jaw; cleft of mouth extending more or less behind eyes; dorsal and anal very low, confluent around tail, dorsal beginning very far behind gill

<sup>8</sup> Versl. Med. Akad. Amsterdam (2) 2 (1868) 332.

openings, which are very small, lateral, and widely separated; teeth small, on vomer and jaws; a lateral line present.

Small marine eels occurring from the Red Sea to Japan, Australia, and the islands of the South Pacific.

*Key to the Philippine species of Murænichthys.*

- a<sup>1</sup>.* Origin of dorsal nearer gill openings than vent..... *M. macropterus.*
- a<sup>2</sup>.* Origin of dorsal not nearer gill openings than vent.
  - b<sup>1</sup>.* Vomerine teeth large, blunt, rounded; origin of dorsal nearer vent than gill openings; jaw teeth in two, three, or four rows.
    - M. gymnopterus.*
  - b<sup>2</sup>.* Vomerine teeth small, sharp pointed; origin of dorsal midway between vent and gill opening. Jaw teeth uniserial.
    - c<sup>1</sup>.* Vomer with two rows of teeth; eye 18 in head..... *M. thompsoni.*
    - c<sup>2</sup>.* Vomer with teeth in one row, imperfectly two rowed or forming a Y; eye 11 to 14 in head..... *M. malabonensis.*

*Murænichthys macropterus* Bleeker.

*Murænichthys macropterus* BLEEKER, Act. Soc. Sci. Indo-Neerl. 2 (1857) 91; Atlas Ichth. Muræn. 4 (1864) 31, pl. 7, fig. 3; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 772; CASTO DE ELERA, Cat. Sist. Fauna Filip. 1 (1895) 588; WEBER and BEAUFORT, Fishes Indo-Austral. Arch. 3 (1916) 275.

The following description is copied from Weber and Beaufort:

Height 27.5-40; head about 7.5, 2 to 2.2 in trunk. Head and trunk about 1.3 to 1.5 in tail. Eye 8-12, twice in snout. Cleft of mouth reaching behind eye. Origin of dorsal nearer to the gill openings than to anus; its distance from vertical through anus nearly 1.2-1.5 longer than head. Mandibular and maxillary teeth small, subconical, in 2 series. Those on the vomer larger and more granular, in two close set series, on the intermaxillary plate is a semicircular row of similar teeth. Color of alcohol specimens brownish. Length 247 mm.

The only specimen I have seen is one that I determined in the museum of the University of Santo Tomas. It differs markedly from the description by Bleeker and from the one cited above in its stouter form, the depth being contained but 18.8 times in the length; the head is contained 8 times in the length and 2.75 in the trunk; the gape is contained 2.5 times in the head. Length, 160 millimeters; depth, 8.5; head, 20; tail, 85; gape, 8. In other respects, however, it is typical.

This specimen came from Mindoro Island; the species has also been recorded from southern Negros by Jordan and Seale.

Since writing the above I have received a specimen from Lingayen, Pangasinan Province, collected January 5, 1923. Its dimensions are as follows: Length, 185 millimeters; depth, 8; head, 28; tail, 110.

This unimportant East Indian species ranges from Singapore northeast to the Philippines, eastward in the Pacific to the Marshall Islands, and south to the Tonga group.

**Murænichthys gymnopterus** Bleeker.

*Muræna gymnopterus* BLEEKER, Verh. Bat. Gen. 25 (1853) Muræna 52.

*Murænichthys gymnopterus* BLEEKER, Verh. Bat. Gen. 25 (1853)

Muræna 71, Atlas Ichth. Muræn. 4 (1864) 32, pl. 6, fig. 1; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 276, fig. on page 418.

*Murænichthys microstomus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 32, pl. 6, fig. 2.

Depth 23.4 to 33.1 in total length (34 to 25, Bleeker), 3.2 to 4.6 in head; head 1.8 to 2 in trunk, 7 to 8 in length; head and trunk together 1.36 to 1.57 in tail; eye from 0.5 to 0.6 as long as snout, 13 to over 15 in head; snout 6.5 to 8.5 in head, the wide mouth from 3.7 to 4.2; origin of dorsal nearer anus than gill openings, the distance being from a little less than down to 0.8 the length of head.

Vomerine teeth large, blunt, rounded, resembling those of the genus *Pisodonophis*, much larger than those of jaws, in two or four rows, or four rows anteriorly and two posteriorly; intermaxillary teeth usually continuous with vomerine, smaller, more or less pointed, and arranged in a semicircle, about six in number; maxillary teeth more or less irregular, usually with three rows, the teeth of the inner one like those of vomer but smaller, and an outer row of sharp-pointed teeth at rear; one small specimen has but two irregular rows of conical teeth; mandible with two rows of rather large blunt teeth and third short row near symphysis.

Small eels with narrow head and blunt, rounded snout, cylindrical body, and with posterior half of tail strongly compressed. A row of large pores on mandible, extending beyond angle of mouth and then curving upward; four pairs of pores on top of snout to eyes and on around them, one behind and two below each eye; lateral line beginning on nape.

Color of a living specimen pale creamy brown, thickly spotted above with minute dusky specks so as to be yellowish brown; belly cream color; a yellow band from chin to gill opening, then

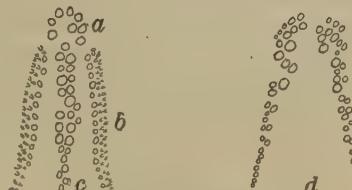


FIG. 2. *Murænichthys gymnopterus* Bleeker, dentition; a, intermaxillaries; b, maxillaries; c, vomer; d, mandibles.  $\times 5$ .

along side, descending gradually and running along base of anal on each side; the caudal, posterior part of dorsal, and anal fin bright yellow; anterior part of dorsal clear, more or less minutely spotted. Color in alcohol dusky gray-brown above, paler to whitish or yellowish beneath, or else uniform brown, everywhere thickly spotted with minute dark specks except on throat and belly, which are therefore paler than rest of body; fins uniform pale gray or yellowish, slightly punctulated.

Measurements of four specimens of *Murænichthys gymnopterus* from Manila Bay.

No.	Length.	Head.	Trunk.	Tail.	Depth.	Eye.	Gape.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
656-----	190	26	52	112	6	2	7
834 a-----	298	42	79	177	—9	—3	10
9491-----	175	23	45	107	7	2	6+
-----	270	38	76	156	11.5	2.5	10

<sup>a</sup> A female nearly ready to spawn.

Without authentic specimens for comparison the disposition of this material is slightly uncertain; my specimens are strongly differentiated from closely related forms by the vomerine teeth, though none of the published descriptions of *Murænichthys gymnopterus* go into details on the teeth further than that they are "conical, more or less obtuse." Weber and Beaufort state "cleft of mouth reaching more than 3 eye diameters behind eye," but this does not agree with their figure and is undoubtedly an error.

This insignificant East Indian eel attains a length of over 30 centimeters and is known from Java to China, the Philippines, and the Fiji Islands. It is frequently seen in the Manila fish markets, coming from the *bangos* fishponds around Manila Bay, where it spawns in July.

There is a specimen from Mindoro in the museum of Santo Tomas, and Jordan and Seale recorded it from Cavite.

As this went to press I received a specimen from Dagupan, Pangasinan Province, having a length of 300 millimeters and a depth of 12 millimeters.

#### *Murænichthys thompsoni* JORDAN and RICHARDSON.

*Murænichthys thompsoni* JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 237, fig. 1.

Head 6.60; depth equal to distance from tip of snout to back of orbit; length of head and trunk equal to .80 of tail; snout 1.33 times eye; cleft

of mouth 2.75 in head, the maxillary extending a distance behind orbit equal to length of snout; eye 18 in head; dorsal origin almost exactly midway between vent and gill opening, the fin very low anteriorly; tail tapered to a sharp point, tipped with short caudal fin continuous with dorsal and anal; no pectorals; gill openings a distance behind eye equal to 2.25 times length of maxillary; vomerine teeth in two rows; teeth in jaws uniserial. Color in spirits light brownish, everywhere finely specked with darker, except on belly, which is pale.

This species is known to us from a single specimen, 3.75 inches long, collected in Manila Bay by Dr. J. C. Thompson, of the United States Navy, for whom the species is named. The type is no. 20201, Stanford University.

In its large mouth and in many other features this eel resembles *Murænichthys macrostomus* Bleeker, but the insertion of the dorsal is different.

In the description cited above the statement "depth equal to distance from tip of snout to back of orbit" is evidently an error, since the figure shows the ratio to be altogether different. I have not been able to recognize this species among the specimens of *Murænichthys* at my disposal.

***Murænichthys malabonensis* sp. nov. Plate 2, fig. 1.**

Depth  $3\frac{1}{2}$  to  $5\frac{1}{2}$  in head and 21.5 to 39 in length; head 1.75 to 2 in trunk and 6.88 to 7.86 in length; head and trunk together 1.46 to 1.61 in tail, which is from 59 to 62 per cent of total length; eye from two-thirds to three-fourths the length of snout and 11 to 14 in head; mouth wide, reaching one or two diameters beyond eye, and 2.75 to 3.7 in head; origin of dorsal midway between gill openings and anus or, in one specimen, nearer anus, its distance from the latter being a sixth less than the length of head.

Teeth very small, conical, sharp pointed, in one row in jaws or, in one specimen, with anterior part of maxillary two rowed and mandible with two rows near symphysis; vomer with one row, or imperfectly two rowed, or with anterior part forming a very short Y followed by a long single row; teeth of intermaxillary plate separated from the others by a groove, forming an inverted V of about five larger teeth, or a small irregular group.

A small elongate eel, body subcylindrical, tail compressed, posterior portion strongly so; a double row of pores on snout, continued on around eyes and below them; a row of large pores on each side of mandible extending beyond angle of mouth, curving up behind it and on over nape, thus continuous with the lateral line, which originates there.

Color in alcohol uniform pale brown; densely punctulated with minute dark specks above the lateral line on trunk and over

entire tail, belly and throat therefore paler than the other parts; fins uniform pale yellowish or slightly punctulated.

I have examined four specimens, three of them females ready to spawn, taken from a bañgos pond at Malabon, Rizal Province, on the shores of Manila Bay.

*Measurements of four specimens of Murænichthys malabonensis from Malabon, Luzon.*

No.	Length.	Head.	Trunk.	Tail.	Depth.	Eye.	Gape.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
839 a-----	175	22	45	108	7	2	7
840 a-----	193	28	50	115	8	2	8
841 a-----	172	24	45	103	8	2	—9
842-----	117	17	30	70	3	1.5	5

<sup>a</sup> Female nearly ready to spawn.

The table shows the great relative difference in depth between the spawning females and the younger, less-mature individuals such as No. 842. In common with other small eels, they spawn at Manila Bay in midsummer, those of this particular species probably about the middle of July.

This species is very close to *Murænichthys thompsoni* Jordan and Richardson, but differs from it in several particulars, such as larger eyes, greater slenderness, greater length of head and trunk in proportion to that of tail, etc. It differs very strongly from *Murænichthys gymnopterus* in the dentition, less so in the position of the dorsal and in some minor points.

## OPHICHTHYIDÆ

### SNAKE EELS

Scaleless, elongate, true eels, having a wormlike or slightly compressed body, the end of the tail extending beyond the vertical fins (which may be well developed, very small or altogether wanting) and lacking even the rudiments of a caudal fin. The pectorals may be fully developed or degraded and entirely absent. The anterior nostrils are in a tube or papilla in the upper lip and open downward. The posterior nostrils are an opening on the inner side of the upper lip within a tumid flap forward of or beneath the front margin of the eye. In a few of the genera the upper lip is fringed with a mustachelike row of barbels while in a number of genera there are two pairs of teatlike papillæ on the upper lip. The tongue is fastened more or less completely to the floor of the mouth. The gill openings are not confluent

and may be large or small, lateral or ventral. Eggs numerous, of medium size, resembling those of ordinary fishes.

Found in temperate and tropical seas throughout, in shallow water on coral reefs and sandy shores, often burrowing. Some species enter fresh-water streams. The genera and species are numerous; the individuals are usually small or medium sized and abound in the crevices of coral reefs. The species are often gaily blotched or banded so that they startlingly resemble true serpents.

By Ilocanos these eels are called *quinet*; in Tagalog they are known as *igat*, *palos*, and *pindangá*; the Visayans use the names *ucdoc*, or *ógdoc*, and *taguibolos*; the Moros call them *taguibus*.

*Key to the genera of Ophichthidae.*

- a<sup>1</sup>.* Brightly colored, spotted, banded, or variegated.
- b<sup>1</sup>.* Vomer with teeth.
  - c<sup>1</sup>.* Dorsal and anal extending almost to tip of tail..... *Myrichthys*.
  - c<sup>2</sup>.* Dorsal ending about the length of head before tip of tail, anal twice length of head or more..... *Chlevastes*.
- b<sup>2</sup>.* No teeth on vomer..... *Leiuranus*.
- a<sup>2</sup>.* Philippine species all dull colored.
- d<sup>1</sup>.* Upper lip with a fringe of barbels..... *Cirrhimuræna*.
- d<sup>2</sup>.* Upper lip without barbels.
  - e<sup>1</sup>.* Pectorals present, gill openings lateral.
    - f<sup>1</sup>.* Teeth blunt, conical or granular, in bands..... *Pisodonophis*.
    - f<sup>2</sup>.* Teeth pointed, sharp, in one or more series..... *Ophichthus*.
  - e<sup>2</sup>.* Pectorals absent.
    - g<sup>1</sup>.* Gill openings ventral, longitudinal or oblique, and with a duplication of the gill membranes anteriorly..... *Lamnostoma*.
    - g<sup>2</sup>.* Gill openings more or less lateral, vertical, transverse or oblique, gill membranes not duplicated by a false fold..... *Caecula*.

Genus **MYRICHTHYS** Girard

*Myrichthys* GIRARD, Proc. Acad. Nat. Sci. Phila. (1859) 58.

A small group of slender, much-elongated eels, distinguished from other closely related genera by having the dorsal and anal fins extend almost to the tip of the tail.

Head small and conical, with a short, pointed, convex snout which overlaps mouth; anterior nostrils in tubes on the flattened lower surface of snout; posterior nostrils wide, concealed in upper lip just below or slightly forward of anterior margin of each eye, and opening downward; tongue adnate; teeth blunt, conical, small, the posterior ones often very small, in two rows in jaws and on vomer; dorsal beginning on nape far in advance of gill openings, both dorsal and anal fins extending almost to tip of tail; pectorals very short and barely visible.

Small reef-dwelling eels occurring throughout the tropical seas, the species few.

**Myrichthys maculosus** Cuvier. Plate 10, fig. 2.

*Muræna maculosa* CUVIER, Regne Animal 2 (1817) 232, note 3.

*Ophisurus maculosus* RICHARDSON, Zool. Voyage Erebus and Terror, Fishes (1844-48) 102.

*Ophisurus ophis* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 65, pl. 16, fig. 3.

*Ophichthys maculosus* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 81; Fische d. Südsee (1910) 401.

*Myrichthys maculosus* WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 284, fig. 129.

Depth 38 to 47 in length; head 14.5 to 17 in length and 5 to 6 in trunk; head and trunk together much shorter than tail, being from two-thirds to three-fourths as long as the latter; eye 8 to 9 in head and 1.5 to 2.5 in the broad, convex snout; mouth moderately large, extending well beyond eye, 3 to 4 in head; dorsal commencing on nape, the vertical fins extending almost to tip of tail; pectorals very small, rounded, their length 6.5 to 10 in head. Teeth on intermaxillary plate largest, conical, about six in number; vomerine teeth in two rows, blunt, conical, extending much farther backward than those in jaws; maxillary teeth small, the forward half in two rows, posteriorly in one row; lower jaw teeth in two rows, the forward ones larger than those at back of mouth.

White or whitish, with three rows of alternating circular brown spots, the middle row largest, the other rows extending on to fins.

A handsome, slender eel, reaching a length of 1 meter. I have examined a specimen in the collection of the Ateneo de Manila, obtained in Surigao, Mindanao, having the following dimensions: Length, 311 millimeters; head, 21; trunk, 109; tail, 181; gape, 7.5; eye, 2.25; snout, 4; pectoral, 3; depth, about 40 in length.

This eel is evidently a greedy feeder, as the belly of this specimen was lumpy with masses of freshly captured prey while the tail of a partly swallowed shrimp projected from its throat.

After the above had been written a fine specimen, 528 millimeters in length, was added to the Bureau of Science collection. It was obtained at Iba, Zambales, February 4, 1922, by Mr. H. R. Montalban. In life the ground color was yellow; this has gradually faded until now it is little evident.

Mr. G. A. Lopez, of the Bureau of Science, also collected a specimen, 370 millimeters long, at Cabalian, Leyte, May 26, 1922.

A marine, reef-dwelling species occurring from Madagascar to the East Indies and on to the South Sea Islands.

Genus CHLEVASTES Jordan and Snyder

*Chlevastes* JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 867.

Elongate, snakelike, the vertical fins low, the dorsal beginning on top of head far in advance of gill openings and ending the length of head before tip of tail; anal ending far before end of dorsal, at least twice the length of head, if not more, before tip of tail; teeth mostly blunt, granular or molar, in two series on jaws and vomer; those of intermaxillary in a group of eight or nine, separated from the rest by an interspace and situated in a furrow between nostrils; pectorals rudimentary.

One species, widely distributed in the tropical seas of the eastern hemisphere. This genus is very close to *Myrichthys*, of which it is made a subgenus by Weber and Beaufort, and differs principally in the disappearance of the anal fin far before the tip of the tail.

*Chlevastes colubrinus* (Boddaert). Plate 4.

*Muraena colubrina* BODDAERT, in Pallas, Neue Nord. Beytr. 2 (1781) 56, pl. 2, fig. 3.

*Ophisurus fasciatus* BLEEKER, Atlas Ichth. Muraen. 4 (1864) 65, pl. 21, fig. 1.

*Chlevastes colubrinus* JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 867.

*Myrichthys (Chlevastes) colubrinus* WEBER and BEAUFORT, Fishes Indo-Austr. 3 (1916) 285, figs. 130, 131.

*Chlevastes fasciatus* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) 195, fig. 5.

*Chlevastes elaps* FOWLER, Proc. Acad. Nat. Sci. Phila. 64 (1912) 18, fig. 3.

In a specimen from Dumaguete, Oriental Negros, having a length of 555 millimeters, the depth is 55.5 in total length; length of head, 28 millimeters; diameter of eye, 2.5; length of head and trunk together, 248; tail, 307; dorsal fin terminates 18 millimeters from tip of tail; anal terminates 59 millimeters from tip of tail. This eel has thirty complete black rings, the first ring on the snout being connected with the second by a broad black band on the underside, the rings all wider than the

interspaces; ground color of body ivory white to brownish white; tip of snout and tip of tail white.

In another specimen, from Puerto Galera, Mindoro, with a length of 628 millimeters, the depth is but 9 millimeters, being thus almost one-seventieth of the total length; head 32 millimeters long, 19½ in total length; head and trunk together 290 millimeters; tail, 335; origin of dorsal 14 millimeters behind tip of snout, or much nearer snout than gill opening; diameter of eye 2.5 millimeters; gape, 9; mouth extends about a diameter beyond eye; dorsal ends 37 millimeters before tip of tail; the anal, 72.

This specimen has thirty-one narrow chestnut brown rings with very much wider pale or whitish tan interspaces, and one or two large circular or irregular chestnut brown spots on each side, or else an incomplete ring in each interspace. This is the variety *fasciata* Günther or *oculata* Bleeker.

A third specimen, from Iba, Zambales, measures 545 millimeters in length and has twenty-eight rings, with occasionally a circular spot between them.

Height 52 to 70 in total length, head, 18 to 21; eye 10 to 14 in head; pectoral fin is reduced to a minute vestigial flap; dorsal fin begins much nearer tip of snout than gill opening; the whole fish is pale, whitish to brown, with from twenty-six to thirty-three black or brown rings which include the fins, tip of snout and of tail being white or light colored; the interspaces may vary greatly in width and may be spotted or blotched in various ways, as in the variety described above, or in the variety *elaps* Fowler, where the broad interspaces contain one to five brown spots or blotches. In the variety *semicincta* Bleeker some or most of the dark rings fail to meet around belly.

This striking-looking eel reaches a length of nearly 1 meter and is particularly snaky looking as it creeps around the crevices of coral reefs. It bears a remarkable resemblance to *Leiuranus semicinctus*, the two species often living in the same hole.

This species occurs from the Red Sea and Zanzibar north to the Riu Kiu Islands, throughout the Indo-Australian Archipelago, and in the western Pacific to Tahiti and New Zealand.

#### Genus LEIURANUS Bleeker

*Leiuranus* BLEEKER, Verh. Bat. Gen. 25 (1852) Muræna 36.

Small, elongate, scaleless, cylindrical eels, with small pectorals and no caudal, the vertical fins low and not confluent; head small, the long, pointed, projecting snout flattened on lower side,

from which hang the tubes of the anterior nostrils; posterior nostrils opening downward in upper lip, concealed by a flap; mouth small, weak, the gape extending little if any beyond eye; tongue adnate; teeth small, pointed, in two rows on maxillaries and one on mandible; none on vomer; lateral line present; gill openings small, vertical, lateral slits, separated by a broad interspace.

Delicate, graceful, brightly colored eels, separated from *Ophichthitus*, *Chlevastes*, and other closely related genera by the absence of teeth on vomer. Found throughout Malaysia to the Riu Kiu Islands, Australia, Hawaii, and the South Sea Islands.

***Leiuranus semicinctus* (Lay and Bennett).**

*Ophisurus semicinctus* LAY and BENNETT, Beechey's Voyage Blossom (1839) 66, pl. 20, fig. 4.

*Leiuranus semicinctus* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 54; JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 866; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 294, fig. 137.

I have examined two specimens of this pretty little snakelike eel; one, 360 millimeters long, from Dumaguete, Oriental Negros, and the other from Sitanki with a length of 278 millimeters. While they agree in most respects with the published accounts, they differ in some particulars: Body elongate, nearly or quite cylindrical, its depth 46 to 60 in total length (46 to 55 in published descriptions); length of head 12 to 15 in total length, 5.6 to more than 6 in trunk. According to authors the head and trunk are one-seventh longer than the tail, but in my specimens the tail is longer. In the smaller one the head and trunk measure 132 millimeters, the tail, 146; in the larger one, 174 and 186, respectively.

Eye small, 1.5 to 2 in snout, which projects one-eighth the length of head beyond mouth; jaws feeble, delicate, gape extending to posterior border of eye or a trifle beyond; pectorals small, about twice eye; dorsal beginning over pectorals; vertical fins low, not quite reaching tip of tail.

The arrangement and shades of color are variable. The Sitanki specimen is yellow and brown in alternate narrow pale yellow and wide dark brown bands; the latter, of which there are twenty-six, do not extend more than halfway down the sides, except the last two on the tail. The other specimen has twenty-six wide dark brown bands which do not meet below, but the interspaces and belly are very pale, almost white. Weber and Beaufort say "black bands continued on fins," but in my specimens the dorsal is all pale.

In general, alcoholic specimens are cream colored to whitish brown, with from twenty-one to thirty-five broad dark brown to blackish bands, much wider than the interspaces; the dark bands may or may not meet below, but often do so on the tail. The tip of the snout and tail are usually pale, but in my larger specimen the tip of the snout is dark.

This species bears a remarkable resemblance to *Chlevastes colubrinus*, with which it dwells in the coral.

A marine species found on coral reefs and along shore, occurring from the Riu Kiu Islands to Queensland, and from the Hawaiian Islands to the Samoan and Fiji groups.

Genus **CIRRHIMURÆNA** Kaup

*Cirrhimuræna* KAUP, Uebersicht der Aale, Archiv. für Naturg. 22 (1856) 52; Cat. Apod. Fishes Brit. Mus. (1856) 27.

Small, slender, elongate, cylindrical eels distinguished from all related forms by the fringe of short, irregularly formed, mustachelike barbels on upper lip; dorsal beginning above or slightly before or behind gill openings; pectorals well developed; head small, elongated, the narrow and pointed snout projecting beyond the large mouth, which extends backward far behind the small eye; teeth small, needlelike, uniform or rarely the inner row larger, mostly depressible, pointed backward, in bands on jaws and vomer, those on intermaxillary plate in a separate group; anterior nostrils short tubes projecting downward and located on each side of snout about a third of the distance from its tip to eye; posterior nostrils opening on inner side of upper lip, just forward of eye or below its front margin; tongue adnate; gill openings small, in front of and somewhat below base of pectorals; a lateral line present; anus in anterior half of length, tail very much longer than head and trunk.

Species few and poorly differentiated; the five nominal ones of the East Indies are probably reducible to two, though more material is necessary to clear this problem. Found from the Red Sea, Zanzibar, and Madagascar to the Philippines, China, and Australia.

*Key to the species of Cirrhimuræna.*

- a<sup>1</sup>.* Maxillary teeth in two rows, the inner one larger..... *C. oliveri*.
- a<sup>2</sup>.* Maxillary teeth of uniform size, in three to six rows.
- b<sup>1</sup>.* Vomerine teeth biserial; cleft of mouth about 3 in head. *C. tapeinopterus*.
- b<sup>2</sup>.* Vomerine teeth in three or four rows; cleft of mouth about 2.5 in head. *C. chinensis*.

*Cirrhimuræna oliveri* (Seale). Plate 2, fig. 2.

*Jenkinsiella oliveri* SEALE, Philip. Journ. Sci. § A 4 (1909) 493.

Depth 40 in length, head 13.4; head 3.57 in trunk; head and trunk 1.79 in tail, which is 1.55 in total length; eye 1.8 in snout and 10.4 in head; snout 5.77 in head; gape 2.88 in head, pectoral  $3\frac{5}{7}$ .

A very elongate cylindrical little eel at once distinguished by its greater slenderness, by the origin of the dorsal being about the length of the pectorals forward of gill openings, and by the teeth, which differ strongly from those of any other species I have examined. Jaw teeth in two rows, the inner row of the maxillaries noticeably larger; vomerine teeth in two rows, merging into one row posteriorly; four pairs of teeth on intermaxillary plate; vertical fins low, the greatest height of dorsal slightly more than half the depth of body; a distinct pore above and somewhat before eye, another behind center of eye; fringe of upper lip beginning immediately behind anterior nostril; lateral line beginning on nape.

Color, light yellowish brown above, yellow below median line, belly whitish, sides finely punctulate with minute black specks, throat white, top of head brown, these two colors uniting in a sharp line on the middle of side of head, extending from angle of fins [= jaws] to gill openings; tip of snout and anterior portion of dorsal darker.—Seale.

I have examined the type and only specimen, Bureau of Science collection No. 4299, collected by Mr. Seale in Zamboanga, and find it to have the following dimensions: Length, 360 millimeters; head, 26; trunk, 103; tail, 231; eye, 2.5; snout, 4.5; gape, 9; pectoral, 7.

Seale states "head 5.10 in body; gape 1.75 in head," but my measurements do not tally with his. He likewise states that the dorsal and anal fins extend to the tip of the caudal, but I find they both stop before the tip of the tail, as in all other ophichthyoid eels I have ever examined. In his color description I have changed the word "fins" to jaws, as fins is evidently a typographical error.

*Cirrhimuræna tapeinopterus* Bleeker.

*Cirrhimuræna tapeinopterus* BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 183; Atlas Ichth. Muræn. 4 (1864) 41, pl. 8, fig. 3; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 291, fig. 136.

*Ophichthys tapeinopterus* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 75.

*Ophichthus tapeinopterus* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 26 (1906) (1907) 6; JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 238.

*Jenkinsella nocturna* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 26 (1906) (1907) 6, fig. 1 (typ. err.).

Depth 2.38 to 3.4 in head and 23 to 34 in total length; head 9.6 to 10.2 in length and 2.24 to 2.5 in trunk; head and trunk together 1.86 to 2 in tail which is therefore about 1.5 in total length; eye from 11.6 to 16 in head and from about 1.5 to 2 in snout, which is 6.8 to 9.66 in head; mouth reaches far behind eyes, its cleft from 2.6 to 3 in head; pectorals 2 to 2.38 in head; origin of dorsal ranges from above gill openings to above first fifth of pectorals.

Teeth small, uniform in size, needlelike, those in maxillaries in bands of three to five rows, broadest posteriorly, those on vomer usually in a narrow biserial band; this is sometimes irregular or in one row forward and two rows farther back, and in one specimen but one row is present; the vomerine band is shorter than the maxillary bands; teeth in mandibles small to very small, the band narrow, biserial or becoming uniserial; teeth on intermaxillary plate minute, few, four to six, more or less irregularly paired.

The head of this delicate little eel is narrow, the slightly convex snout sharp and pointed; lower jaw noticeably thin, flat, and weak; body cylindrical, tail full and rounded, becoming compressed only near its tip; lateral line beginning on nape.

Color in life usually semitranslucent pale cream gray, shading to ivory beneath, or very pale gray-brown, or sometimes olive above; upper half of body densely sprinkled with minute dusky dots which obscure the ground color, fins colorless or more or less slightly sprinkled with dots. Color of alcoholic specimens similar but darker, or finally uniform clear light brown, the

Measurements of ten specimens of *Cirrhimuræna tapeinopterus* from Manila Bay.

Length.	Head.	Trunk.	Tail.	Depth.	Length.	Head.	Trunk.	Tail.	Depth.
mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
170	17	40	113	5	264	26	66	172	10
172	18	42	112	5.5	279	29	66	184	10
201	22	47	132	8	296	29	72	195	9
238	24	55	154	8	300	31	73	196	13
* 241	25	56	160	10	* 301	31	70	200	10

\* Gravid female ready to spawn; the eggs are evidently laid in June or July.

upper half of body darkened by minute dots densely scattered over it, these few or absent below; throat much paler; fins unspotted or very lightly dotted, yellowish, paler than body.

This is a common eel in Manila Bay and the *bangos* fish ponds, and is often seen in the Manila fish markets, where I have obtained many living specimens. All the specimens described by Jordan and his colleagues have been from Manila Bay. In the museum of the University of Santo Tomas is a specimen labeled Mindoro. Elsewhere it is known from Java, Celebes, and Flores, and undoubtedly occurs in shallow sandy bays and brackish waters throughout the Philippines.

I am unable to separate this species and *Jenkinsiella nocturna*. The figure of the last named does not agree with the description but does agree fairly well with the present disposition.

*Cirrhimuræna chinensis* Kaup.

*Cirrhimuræna chinensis* KAUP, Cat. Apod. Fishes Brit. Mus. (1856) 27; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 292, figs. 134, 135.

*Cirrhimuræna polyodon* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 41, pl. 8, fig. 1.

*Ophichthys chinensis* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 75.

Depth 28.4 to 35 in length, head 8.5 to nearly 9.5; head 2.25 to 2.4 in trunk; head and trunk together 1.7 to about 2 in tail; eyes about 2 in snout and 16 to 19 in head; mouth reaching far behind eye, 2.5 to 2.7 in head; pectorals more than 2 in head; teeth fine, needlelike, in four to six rows on maxillaries, most numerous posteriorly; a band of three or four rows on vomer; teeth on mandibles very minute, the bands reduced, becoming a single row of larger teeth posteriorly; intermaxillary plate with a group of nine or ten teeth as in Weber and Beaufort's figure; lateral line beginning on nape; vertical fins low, dorsal beginning over or slightly behind gill opening, posteriorly emarginate and much the highest near tip of tail, somewhat as in Bleeker's figure.

Color brown above, paler on belly, very light on throat, and light brown on underside of tail.

I have placed here a badly preserved specimen collected at Cavite in 1907. It is a female nearly ready to spawn and is therefore stouter than the specimens described by authors. Its dimensions are as follows: Length, 370 millimeters; head, 39; trunk, 96; tail, 235; depth, 13; eye, 3; snout, 6; gape, 15.

There is also a specimen in the museum of the University of Santo Tomas, from Manila Bay.

This species is found on coral reefs and along shore and is said to occur from Madagascar to China and the Philippines.

Genus **PISODONOPHIS** Kaup

*Pisodonophis* KAUP, Uebersicht der Aale, Arch. für Naturg. 22 (1856) 47.

Much elongated, cylindrical eels with the origin of dorsal above or behind the well-developed pectorals; head of medium size, the pointed snout projecting beyond mouth, the cleft of which reaches below hind border of eye or beyond; eyes small, in the first third or fourth of head; posterior nostrils a slit on inner side of upper lip, below or in advance of front border of eye; anterior nostrils a short tube on edge of snout; teeth blunt, granular, subequal, in several series forming bands; those on intermaxillary plate in a group next to or separated from the other teeth; gill openings moderate or small, before and somewhat below base of pectorals; lateral line present; anus in or behind middle of length.

Slender, plainly colored fishes occurring from the Red Sea and Madagascar to Japan, Australia, and Samoa. Kaup's original spelling has been followed.

*Key to the species of Pisodonophis.*

*a*<sup>1</sup>. Origin of dorsal well behind tip of pectorals..... *P. boro*.  
*a*<sup>2</sup>. Origin of dorsal over middle of pectorals or before..... *P. cancrivorus*.

*Pisodonophis boro* (Hamilton Buchanan).

*Ophisurus boro* HAMILTON BUCHANAN, Fishes Ganges (1822) 20, 363.

*Pisodonophis boro* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 62, pl. 20, fig. 3; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 297, figs. 138, 140, 141.

*Ophichthys boro* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 77.

Depth 32 to 41.5 in length, head 9 to 12.5 in length and 3.2 to 3.6 in trunk; head and trunk a little more or less than 1.5 in tail (in my specimens 1.59 and 1.63); eye prominent but small, 8.8 to 12.5 in head (to 17, Weber and Beaufort), 1.3 to a little more than 2 in snout, which is depressed, projecting much beyond mouth, the tip blunt; tube of anterior nostrils more than half the diameter of eye, the posterior nostrils under front margin of eyes; mouth wide, extending well beyond eyes, 3.3 to 3.5 in head; the tumid upper lip overlaps upper jaw and intermaxillary teeth, as in many other Ophichthyidae; pectorals 4 to 4.5 in head; origin of dorsal more than twice the length of pectoral behind gill opening; both vertical fins very low; teeth

granular, blunt, conical, or rounded, those on maxillaries in bands of four somewhat irregular rows; those on intermaxillary plate much larger, about a dozen in my examples but often more numerous and forming a large oval group of very coarse teeth; vomerine teeth continuous with those on intermaxillary, forming a long four-rowed band extending farther back than those in jaws; teeth on mandibles in bands of two rows, becoming three rowed and coarser at symphysis. The teeth in older specimens are much coarser and the bands wider than in the younger ones, so that there is great variation.

Four pairs of conspicuous pores on snout, the last opposite middle of eyes; similar pores on upper lip and curving up around eye; a row on lower jaw and two behind and a little below rictus; origin of lateral line far forward, on occiput.

Color of alcoholic specimens a dark leaden hue above, merging into pale, almost white below, everywhere densely punctulate with myriads of fine dark dots; also blackish brown above, lighter below.

Here described from two specimens, 513 and 598 millimeters long, in the Bureau of Science collection, collected at Alaminos, Pangasinan Province, through the kindness of Mr. Eugenio Félix. I have also seen a very fine specimen in the Santo Tomas museum, having a length of 705 millimeters, which was obtained from Manila Bay. This species has been recorded from "Zebu" (Cebu) by Günther and from "the Philippines" by Fowler.

Since this went to press Chaplain Joseph Clemens collected a fine specimen, 780 millimeters long, at San Fernando, Pampanga, and I obtained one at Vigan, Ilocos Sur, 1,035 millimeters long.

This eel is found in both salt and fresh water, ascending rivers for some distance. It occurs from British India throughout the East Indies to New Guinea, the southern coast of China, and Formosa.

#### *Pisodonophis cancrivorus* Richardson.

*Ophisurus cancrivorus* RICHARDSON, Voyage Erebus and Terror, Fishes (1844) 94, pl. 50, figs. 6-9.

*Pisodonophis cancrivorus* KAUP, Cat. Apod. Fishes Brit. Mus. (1856) 15; JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907)

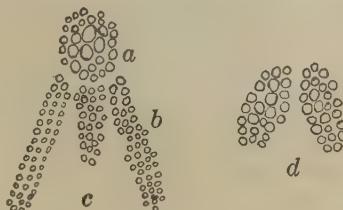


FIG. 3. *Pisodonophis boro* (Hamilton Buchanan), dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 2$ . After Weber and Beaufort.

(1908) 238; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 300.

*Pisodonophis zophistius* JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 868, fig. 15.

*Pisodonophis macgregori* JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 238, fig. 2.

Depth 22 to 35.78 in total length; head 8 to 10 in total length and 2 to more than 3 in trunk; head and trunk together from 0.63 to 0.7 of tail and 1.4 to 1.6 in tail, which is 1.6 to 1.7 in total length; eye 8 to 12 in head, and 1.6 to 2 in snout; gape 2.7 to more than 3.5 in head; pectoral contained about 3 to 4 in head; origin of dorsal varies from a point over gill opening to 0.5 the length of pectoral from origin of latter. Teeth granular or rounded, mostly uniform in size, arranged in triserial bands on jaws and a biserial band on vomer; soft palate and lips overlapping bands so that they appear narrower than they really are; teeth on intermaxillary plate numerous, more or less separated from the other teeth by a slight interspace; Richardson says "nasal disk circular, armed with about 15 crowded . . . teeth," but I find from eight to ten, usually arranged in pairs, the second and third pairs largest; they are so covered over by the nasal tubes and lips as to be difficult to observe. A small papilla protrudes from a notch in the upper lip about halfway between the anterior nostril and the eye, and a similar but much smaller one is below the eye immediately behind the posterior nostril; there are rows of large mucus pores along the jaws and behind the eye, as shown in the figures cited above. Richardson states there are "three on each side of the snout above and before the eye" but he missed another pair which lies between the eyes, directly opposite the pupils. One of my specimens has pores behind the angle of the jaw exactly as in Jordan and Snyder's figure of *P. zophistius*; some have one or two, but most of the specimens lack them altogether.

Color in life dusky brownish above, paler yellowish below; in alcohol varying from very pale yellowish to dark brown, paler below; nearly all specimens are thickly sprinkled with minute dark brown dots as in Jordan and Richardson's figure of *Pisodonophis macgregori*. Dorsal and anal edged more or less with blackish, the dorsal sometimes with a dusky spot near its origin; pectorals all pale in my specimens and in one specimen all the fins are colorless.

This eel is found in the seas, bays, and brackish waters from Arabia and Madagascar to Japan, Australia, and the Samoan

Islands, and attains a length of nearly a meter. I have examined numerous specimens, ranging in length from 268 to 662 millimeters, from Manila Bay, Dumaguete, and Mindanao. Previously listed in the Philippines from Manila Bay and from Cuyo Island. This eel and similar Ophichthyidæ are frequently seen in the markets and are much esteemed as food, all of them being known in Tagalog as *igat*, though the name *pindangá* is also sometimes applied.

#### Genus OPHICHTHUS Ahl

*Ophichthus* AHL, De Muraena et Ophichtho (1789) 3; JORDAN and SNYDER, Proc. U. S. Nat. Mus. 22 (1901) 871.

*Ophichthys* BLEEKER, Günther, and most recent authors (corrected spelling); WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 300.

Much-elongated and cylindrical snakelike eels, the tail often bulkier and deeper than the trunk, separated from closely related genera by their conical, sharp, subequal teeth, without canines, in one or more series in jaws and on vomer; teeth of intermaxillary plate in a group, in pairs, or in a row of single teeth, separated from the other teeth; pectoral fins well developed; origin of dorsal behind head, and may be above gill openings or the pectorals, or slightly behind end of latter; both dorsal and anal end a short distance before tip of tail; gill openings small or medium sized, in front of and somewhat below base of pectorals; the pointed snout usually projects beyond mouth, the cleft of which reaches below hind border of eye, or beyond; upper lip with two prominent papillæ on each side; a lateral line present; anus somewhat before or much behind the middle of length.

In most representatives of this genus the color is more or less uniform brown, varying from glistening light brown to blackish brown, becoming paler on belly and throat, which may be gray or whitish; a close examination shows that the color is due to a vast number of minute brown or blackish dots thickly sprinkled over the back, sides, and fins; where they are less numerous or absent, as on the throat, the ground color alone shows.

A large genus, found throughout the tropical seas, the species very numerous.

The teeth on the intermaxillary plate are, in most species, much beyond the tip of the lower jaw and would therefore seem to be useless appendages. Whatever function they may fulfill, if any, they are subject to numerous irregularities in number and arrangement, and are apparently often broken or damaged,

judging from the appearance of numerous specimens I have examined. While they may be a useful diagnostic character, their value as such is not determinative but merely corroborative.

*Key to Philippine species of Ophichthus.*

- a*<sup>1</sup>. Maxillary teeth in one row or posteriorly in two rows.
  - b*<sup>1</sup>. A broad black crossband on nape, broadly edged with white or yellowish..... *O. cephalozona*.
  - b*<sup>2</sup>. Coloration uniform.
    - c*<sup>1</sup>. Depth less than 40 in length; head less than 3 in trunk.
    - d*<sup>1</sup>. Vomerine teeth in two rows..... *O. grandoculis*.
    - d*<sup>2</sup>. Vomerine teeth in two rows anteriorly, one row posteriorly.
      - O. apicalis*.
  - c*<sup>2</sup>. Depth over 40 in length.
    - e*<sup>1</sup>. Vomerine teeth anteriorly in two rows; posteriorly in one.
      - O. macrochir*.
    - e*<sup>2</sup>. Vomerine teeth in two rows or anteriorly in three.
      - O. manilensis*.
- a*<sup>2</sup>. Maxillary teeth in two rows.
  - f*<sup>1</sup>. Vomerine teeth in two rows anteriorly, one row posteriorly. Depth 46 to 50 in length..... *O. rutidodermatoides*.
  - f*<sup>2</sup>. Vomerine teeth in two rows anteriorly, three rowed posteriorly. Depth 30 to 36 in length..... *O. celebicus*.

*Ophichthus cephalozona* (Bleeker).

*Ophichthys cephalozona* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 49, pl. 12, fig. 2; GÜNTHER, Fische d. Südsee 3 (1910) 398; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 303, figs. 143 and 144. *Ophichthus cephalozona* JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1910) 872.

Depth 28 to 33 in total length, head 10 to 11, and 3.5 to 4.5 in trunk; head and trunk usually less than tail (contained 1.8 times in it in my specimen), but according to Günther the tail

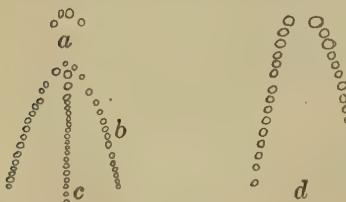


FIG. 4. *Ophichthus cephalozona* (Bleeker), dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 2.5$ .

may be either longer or shorter than body. Eye 10 to 11 in head, 1.75 to 2 in snout, which is bluntly pointed and projecting and about 5.5 in head; gape 3 to 3.5 in head and reaching slightly behind eyes; tubes of anterior nostrils prominent, projecting downward; posterior nostrils just forward of eyes, with a small papilla before and a minute one behind each; pectorals small, from more than 3 to 4 times in head; one pair of pores on tip of snout followed by four pairs extending back on

with a small papilla before and a minute one behind each; pectorals small, from more than 3 to 4 times in head; one pair of pores on tip of snout followed by four pairs extending back on

top of head to opposite pupil of eye; pores on sides of head and behind mouth as in Bleeker's figure. Teeth on premaxillary plate large, stout, pointed, forming a separate group of two or six; teeth in jaws and on vomer in one row, pointed, curved, fixed, those in front of lower jaw larger.

Color in alcohol a yellowish brown, paler beneath; a large broad blackish band on nape, with a broad pale yellowish band before and a narrower pale band behind it; dorsal beginning above posterior end of pectoral; both dorsal and anal with brownish base, a black or dark line along middle, and very pale margin.

I have examined one specimen taken at Cavite, with a length over all of 432 millimeters. Recorded also from Cebu by Günther. This distinctly marked species attains a length of almost a meter and occurs throughout the East Indies, northward to Japan, south and eastward to the Pelew Islands, North Australia, and the Tonga Islands.

#### *Ophichthus grandoculis* (Cantor).

*Ophisurus grandoculis* CANTOR, Cat. Malayan Fishes, Journ. Roy. Asiat. Soc. Bengal 18 (1849) 324, pl. 5, fig. 3 (teeth).

*Ophichthys grandoculis* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 48, pl. 47, fig. 5; GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 71.

*Ophichthus grandoculis* JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 238.

Depth 27.2, head 9.5 in total length and 2.6 in trunk; head and trunk together equal 62 per cent of tail, which is in turn 61.8 per cent of total length; eyes moderately large, their upper margin flush with profile, 9.5 in head and 1.5 in snout, the latter 6.1 in head; mouth extends well behind eyes, its gape 3.7 in head; teeth subulate to rounded, in one row in jaws except about symphysis of mandibles, where they are slightly two rowed; four rather bluntly pointed teeth on premaxillary and a double row on vomer, anterior ones largest; pectorals 2.6 in head; height of dorsal about one-third the depth of body and it begins just before middle of the reflexed pectoral.

Body everywhere very finely punctulated with minute dusky specks, over a pale whitish yellow ground color; on top of head

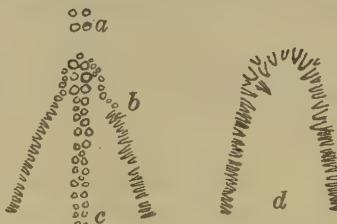


FIG. 5. *Ophichthus grandoculis* (Cantor), dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 3$ .

and along dorsal line these specks coalesce or are so close together that the animal is nearly uniform dusky olive, becoming paler below the lateral line and light colored along underside; fins grayish, dorsal and anal edged with black, pectorals posteriorly dusky.

Here described from a female specimen nearly ready to spawn, collected at Jordan, Guimaras, in June, 1922, by Mr. H. R. Montalban. Its dimensions are as follows: Length, 409 millimeters; head, 43; trunk, 113; tail, 253; eye, 4.5.

This rare species was described by Cantor from specimens obtained at Pinang and has not been recorded by any other authors except Jordan and Richardson, who determined as *Ophichthus grandoculis* a specimen obtained by Mr. R. C. McGregor in Manila.

*Ophichthus apicalis* (Bennett).

*Ophisurus apicalis* BENNETT, Cat. Zool. Spec. in Memoir, Life of Raffles (1830) 692.

*Ophichthys bangko* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 51, pl. 14, fig. 1.

*Ophichthys diepenhorsti* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 52, pl. 15, fig. 4.

*Ophichthys apicalis* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 70; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 305, fig. 145.

Depth 27 to 36.6 and head 8.5 to 10.4 in total length; head 2.4 to 2.7 in trunk; head and trunk together 1.4 to 1.71 in tail; eye  $8\frac{2}{3}$  to  $12\frac{2}{3}$  in head,  $1\frac{1}{2}$  to  $2\frac{2}{3}$  in the projecting, bluntly pointed snout; mouth extending from just behind eye to a trifle more than diameter of eye behind it and contained from 3.3 to 3.6 in head; pectorals 2.55 to  $3\frac{1}{3}$  in head; dorsal low, its origin approximately above the middle or last part of pectorals in my specimens, but according to authors "commencing somewhat before or behind end of pectorals;" dorsal and anal fins expanded or higher near tip of tail; teeth pointed, conical, those of jaws in one row ("they may form anteriorly or near the middle an irregular double series," Weber and Beaufort); in two of my specimens the anterior teeth of mandible are in two rows; on the forward half of vomer the teeth are stouter and two rowed, usually irregularly arranged; posterior half with one row; No. 1449, Bureau of Science collection, has the vomerine teeth in three rows, becoming reduced to two rows posteriorly and the last few teeth uniserial; teeth on intermaxillary plate variable, four to six in my specimens, arranged irregularly or in pairs; lateral line prominent, the wide-spaced pores as in Bleeker's

figure of *Ophichthys diepenhorsti* but beginning on top of head, halfway between gill openings and tip of snout.

The ground color in life is light gray, varying to whitish on belly and throat; darkened to dark gray or dusky above the lateral line by innumerable minute dots which are absent only on belly and throat.

Color in alcohol pale brownish gray to dark brown, paler brown to whitish below, especially on belly and throat; thickly sprinkled, especially above, with minute dark brown dots, which are absent on belly and underside of head; fins dusky to colorless in my material, but black or with a black margin according to authors.

This inconspicuous little eel is easily recognized by its dentition and the relative proportions of head and tail. The body is plump, the transverse diameter nearly or quite equal to the depth. The head is small, the lower jaw weak, much shorter than the upper one.

As usual in this group the throat is longitudinally striate or pleated and much inflated.

I have examined five living specimens from the Manila market, and numerous alcoholic specimens from Malabon, Manila, Mindoro, Dumaguete, Cagayan de Misamis, and Davao, Mindanao. They vary in length from 181 to 345 millimeters.

This species attains a length of 430 millimeters; it occurs in seas and bays throughout the East Indies from Singapore to Celebes, and northward to the coast of China.

#### *Ophichthus macrochir* (Bleeker).

*Ophisurus macrochir* BLEEKER, Verh. Bat. Gen. 25 (1852) Muræn. 26.  
*Ophichthys macrochir* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 54,  
pl. 20, fig. 1; GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 72; WEBER  
and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 306.

Depth 42 to 55.5, head from 14.5 to 17.7 in total length; head 4 to 5.3 in trunk; head and trunk 1.7 to about twice in tail; eye 10.4 to 13 in head, and about twice in snout, which is 5 to 6 in head; cleft of mouth extending just behind eye, 2.9 to 3.6 in head; pectorals 3 to 4.5 in head; origin of dorsal opposite last quarter of pectorals or farther behind, in my smaller specimen about the length of pectoral behind its tip; vertical fins low, the anal the higher, less than one-half depth.

Teeth very small, pointed, all uniserial except on anterior portion of vomer where they are in two rows and strongest; intermaxillary teeth said to be in about three pairs, but in my material there are but two teeth in a row in one specimen

while in the other they are broken out but were originally in a single row also.

This is a delicate and slender eel with small head and weak jaws, snout convex and rather bluntly pointed; posterior nostrils partly below front margin of eyes; lateral line prominent, the pores beginning on neck; tail deeper than trunk.

Color uniform brown, paler on belly, much paler on throat; fins pale yellow brown, or else hyaline from the action of the preservative.

No. 130, Bureau of Science collection, from Cavite, has the following dimensions: Length, 444 millimeters; depth, 8; head, 26; trunk, 138; tail, 280; eye, 2.5; snout, about 5; gape, nearly 9; pectoral, 8.

I have also placed here a specimen from the University of the Philippines, supposed to have been collected at Cavite likewise, which has a single instead of a double row of teeth on the vomer, but which otherwise agrees with No. 130; its dimensions are as follows: Length, 284 millimeters; head, 18; trunk, 84; tail, 182; depth, 5.25.

My material is slenderer than the specimens described by Bleeker and others; they state the depth to be from 42 to 48 times in the length. As elsewhere noted, the teeth of the intermaxillary plate are exceedingly variable as well as subject to numerous accidents, while the teeth occurring in two or more rows are prone to individual variations and irregularities.

Hitherto known only from Java and Sumatra; it lives in the sea and in brackish water.

*Ophichthus manilensis* sp. nov. Plate 5.

Depth 51.69 to 54.2, head 17.68 to 16.6 in length; head 5 to 5.4 in trunk, the latter a trifle more than twice in tail; head and trunk together 1.73 to 1.75 in tail, which is 0.63 of total length. Eyes full, somewhat elliptical, 2 or 2.4 times in snout and 12.4 to 15.2 in head; snout 6.2 to 6.3 in head, its tip rounded; mouth large, extending beyond eyes, 3.1 to 3.4 in head; pectorals large and rounded in life, 3.4 to 3.87 in head; origin of dorsal over the beginning of the last fourth of pectoral.

An elongate and very slender eel but with the body full and rounded, the tail bulkier and deeper than the trunk, its transverse diameter equal to its depth; dorsal and anal fins low, less than half the depth of body; lateral line starting on nape; posterior nostrils just forward of a vertical line from eyes. Maxillary teeth in one row or in two rows on posterior part; teeth of lower jaw in one row; teeth on vomer in two rows or with

a third poorly developed inner row on anterior half; intermaxillary plate with three larger teeth in a single row, the first one the largest.

Skin on dorsal surface between lateral line and dorsal fin curiously folded and reticulated by longitudinal wrinkles; a double row of four pairs of pores on top of snout, curving around eyes and joining another row on upper lip above rictus; a row of pores also on each side of lower jaw.

Color in life greenish brown above, pale yellow to gray brown beneath, everywhere thickly sprinkled with minute dark specks; iris of eyes golden, pupil black.

Color in alcohol uniform brown, paler on belly, throat grayish brown; fins heavily sprinkled with minute dark dots so as to appear uniform grayish brown.

The type, Bureau of Science collection No. 9477, is from a collection made at Cavite in 1907. The cotype, No. 9488, I obtained alive in the Tondo market, Manila; it was brought from some *baños* fishpond in Bulacan, along with a large quantity of *Synbranchus bengalensis*.

*Measurements of Ophichthus manilensis.*

	No. 9477.	No. 9488.		No. 9477.	No. 9488.
Length	mm. 672	mm. 515	Eye	mm. 2.5	mm. 2.5
Depth	13	9.5	Snout	6	5
Head	38	31	Gape	12	9
Trunk	206	157	Pectoral	11	8
Tail	428	327			

I place here tentatively a small delicate eel from Malabon, Bureau of Science collection No. 837, until additional material is available, as I do not wish to multiply new species unduly. As yet we know so little of the differences in ophichthyoïd eels due to age, and the intermaxillary teeth are so readily broken, that it is unsafe to give new names where we have any reason to believe that two forms might possibly belong together.

Depth 55, head 15.7 in length; head 4.89 in trunk; head and trunk together  $1\frac{1}{2}$  in tail; eye 2.5 in snout, 14 in head; snout acute, pointed, 5.6 in head, pectoral 4; cleft of mouth extends beyond eye and is 2.8 in head; maxillary teeth in one row anteriorly, in two rows posteriorly; those on vomer in two rows anteriorly, and in one row at back end; teeth in mandibles are in one row except that those on front half of left side are in two rows; there is a row of two teeth on intermaxillary plate.

Tail deeper than body; origin of dorsal fin behind pectoral; posterior nostrils before eyes; lateral line prominent, the pores continuous from nape.

Color uniform blackish brown above, paler on sides, becoming slaty brown on belly and throat; fins slightly paler but uniform in color with body.

This specimen has the following dimensions: Length, 440 millimeters; depth, 8; head, 28; trunk, 137; tail, 275; eye, 2; snout, 5; gape, 10; pectoral, 7.

A specimen from Mindoro, in the museum of the University of Santo Tomas, apparently belongs here also. The skin of the whole body, excepting only the head, is roughened by an encysted parasite. The vomerine teeth are in three rows anteriorly; the origin of the dorsal is behind the pectorals.

This species is separated from other East Indian members of the genus by marked differences in the relative length and depth and in the dentition.

**Ophichthus rutidodermatooides (Bleeker).**

*Ophisurus rutidodermatooides* BLEEKER, Verh. Bat. Gen. 25 (1852)  
Muræna 31.

*Ophichthys rutidodermatooides* BLEEKER, Atlas Ichth. Muræn. 4 (1864)  
pl. 16, fig. 1.

*Ophichthys rhytidodermatooides* GÜNTHER, Cat. Fishes Brit. Mus. 8  
(1870) 62; WEBER and BEAUFORT, Fishes Indo-Austr. Arch 3  
(1916) 309, fig. 147.

Depth 46 to more than 50 in total length; head 15 to 16.5 and 4 to nearly 5 in trunk; head and trunk together about one-half of tail (five-ninths in my specimen); eyes very small, elongate,  $2\frac{1}{3}$  in snout and  $11\frac{1}{3}$  in head; head small, with weak jaws, the lower one particularly so, the long and sharply pointed snout projecting more than half its length beyond mandible; cleft of mouth extending well behind eyes, and contained from less than 3 to 3.5 in head; anterior nostrils in short tubes pointing downward, and behind tip of snout; posterior nostrils below anterior margin of eyes; pectorals from 3 to 3.4 in head; intermaxillary plate with four comparatively large, irregularly placed teeth, the lower jaw not extending to them; all teeth fixed, pointed, those in jaws in two rows except the first few in the maxillaries, which are in one row; teeth on forward part of vomer in two rows, changing to one row posteriorly; general arrangement of teeth as in Weber and Beaufort's figure, but differing somewhat in detail; dorsal and anal low, the latter apparently the higher in my specimen but both so closely appressed as to make their

measurement difficult, not quite half the depth of body; dorsal beginning a little forward of extremity of pectorals; lateral line conspicuous.

Color in alcohol blackish brown, slightly paler below, fins all dark. The spots shown in Bleeker's figure are lacking in my specimen.

Body very elongate and snakelike, rounded, not flattened except at very tip of tail.

I have examined a specimen, No. 3417, Bureau of Science collection, from Davao, Mindanao, having the following dimensions: Length, 560 millimeters; head, 34; trunk, 166; tail, 360; depth, 11; eye, 3; snout, 7; gape, 12.

Heretofore recorded from Java, Pinang, and Ceylon. I have followed Bleeker's spelling and not the alteration made by Günther.

*Ophichthus celebicus* (Bleeker).

*Ophisurus celebicus* BLEEKER, Act. Soc. Sci. Indo-Neerl. 1 (1856)  
Visschen Menado, 70.

*Ophisurus broekmeyeri* BLEEKER, Act. Soc. Sci. Indo-Neerl. 1 (1856)  
Visschen Menado, 71.

*Ophichthys amboinensis* BLEEKER, Ned. Tijdschr. Dierk. 2 (1864-1865)  
45, Atlas Ichth. Muræn. 4 (1864) 54, pl. 45, fig. 1.

*Ophichthys broekmeyeri* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 53,  
pl. 15, fig. 1.

*Ophichthys celebicus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 54, pl.  
15, fig. 3; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916)  
311.

Depth 30.5 to 36 in length; head  $2\frac{1}{2}$  to 2.77 in trunk, 9 to 9.83 in length; head and trunk together from 0.62 to about 0.75 of tail, which is nearly two-thirds the total length; eyes moderately large, 11 to 12.4 in head and twice in snout, which is about 6 in head; pectorals about 3 in head (2.58 in my specimen); posterior nostrils in advance of eyes, the opening beneath their forward margin. Maxillary teeth irregularly two rowed, those in lower jaw in one row, except at tip where they are in two rows for a short distance; vomerine teeth in two rows, becoming irregularly three rowed posteriorly; teeth on intermaxillary plate in two or three pairs; teeth not uniform in size,

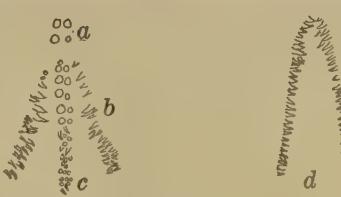


FIG. 6. *Ophichthus celebicus* (Bleeker),  
dentition: a, intermaxillary plate; b, maxillaries; c, vomer; d, mandibles.  $\times 3$ .

those on forward end of vomer largest, with their points more or less curved backward.

A small eel with pointed snout and rounded body, only posterior portion of tail being laterally compressed; origin of dorsal over middle or posterior third of pectoral; vertical fins low, less than half the depth of body, ending a little more than the diameter of eye from tip of tail.

Color in alcohol dark purplish brown, paler on underside of head and forward half of belly; everywhere thickly sprinkled with minute dark red-brown dots, these excessively abundant on dorsal surface; fins speckled like body.

A specimen from Malabon, Bureau of Science collection No. 835, has the following dimensions: Length, 305 millimeters; head, 31; trunk, 86; tail, 188; eye, 2.5; snout, 5; gape, 8; pectoral, 12.

This eel has been previously recorded only from Celebes, Amboina, and Nias Islands; it attains a length of 486 millimeters.

#### Genus **LAMNOSTOMA** KAUP

*Lamnostoma* KAUP, Uebersicht der Aale, Arch. Naturg. 22 (1856) 49;  
Cat. Apod. Fishes Brit. Mus. (1856) 23.

Slender, cylindrical, small eels, with very sharp-pointed and much-projecting snout so that the mouth is far back, as in certain sharks; the anterior nostrils are on the flat undersurface of snout, near its tip, and have a broad, ear-shaped margin, broadest posteriorly and with a small cutaneous tag or flap on middle of inner edge. The gill openings are ventral, close together, small oblique slits curving outward posteriorly, and with an outer and much longer fold of the gill opening duplicating them and extending much farther anteriorly. Dorsal and anal very low, the former beginning a short distance back of gill openings; no pectorals. Anus a little before or behind the middle of length. Teeth uniserial.

A small genus of the southern and southeastern Asiatic waters. Closely related to *Sphagebranchus*, from which it differs in having fins, and in having nostrils of dissimilar character.

#### **Lamnostoma orientalis** (McClelland). Plate 6, fig. 1.

*Dalophis orientalis* McCLELLAND, Calcutta Journ. Nat. Hist. 5 (1845) 213.

*Lamnostoma pictum* KAUP, Cat. Apod. Fishes Brit. Mus. (1856) 23, fig. 11.

*Sphagebranchus orientalis* KNER, Novara Fische (1865-67) 380; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 321, fig. 154, b.

*Ophichthys orientalis* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 87; DAY, Fishes of India (1878-88) 665, pl. 171, fig. 1.

Depth 30.55 to 35.5 in length, head 7.88 to a trifle more than 8, and 2.88 to 3.1 in trunk; tail about same length as, or a little more or less than, head and trunk together; eyes small, 14.4 to 20 in head and 3 to 3.4 in snout, which is very sharp pointed and much exceeds mouth; measured from tip of snout to angle of mouth, the gape is contained from 3 to 3.5 in head; anterior nostrils on the flat undersurface of snout near tip, the margin wrinkled and earlike, longest posteriorly; posterior nostrils in upper lip, looking downward, before eyes, just behind a pendulous papilla; origin of dorsal very close to gill openings, the distance between being one-seventh to one-ninth the length of head; the vertical fins are low but plainly evident and are interrupted posteriorly by an interspace where they are reduced to a fold, becoming expanded again and terminating near tip of tail, as shown in the figure; teeth in one row in jaws and on vomer, very small, acute, and nearly uniform in size, those of lower jaw a little stouter and longer; three or four pairs of stouter teeth on intermaxillary plate, almost concealed by the overlying flaps of upper lip; gill openings ventral, oblique, close together, curved and converging anteriorly; the anterior gill membranes form a longer duplication just outside of and extending farther forward than the gill openings; a row of paired pores on snout, extending around eyes, and a less conspicuous row on lower jaw; lateral line originating on occiput.

Color of alcoholic specimens uniform dark brown above, becoming paler on sides and yellowish brown beneath; upper part of body speckled with innumerable minute dark dots; chin and throat much paler; a series of round whitish spots across occiput and a short whitish bar composed of similar spots directed forward along each side toward eyes; whitish around eyes and along upper lips.

A small eel, the body as broad as deep, very abundant at Madras and along the coasts of India and Ceylon; also known from Madagascar and a single specimen from British New Guinea. The lower jaw is noticeably weak, the contour of snout and jaws very similar to that of the *Cirrhimurænidæ*.

Here described from three typical specimens in the collection of the College of Agriculture at Los Baños. Their dimensions are given in the table.

Measurements of three specimens of *Lamnostoma orientalis*

Length.	Depth.	Head.	Trunk.	Tail.
mm.	mm.	mm.	mm.	mm.
275	9	34	104	187
280	9	35	110	145
142	4	18	52	72

### Genus CÆCULA Vahl

*Cæcula* VAHL, Skr. Naturh. Selsk. Kjøbenhavn 3 (1794) 2, 149; JORDAN and DAVIS, Apodal Fishes America and Europe, Report U. S. Comm. Fish. 16 (1882) (1892) 622.

A small genus related to *Sphagebranchus* from which it is separated by the possession of more or less developed fins, and the presence of enlarged teeth on the vomer, and from *Lamnostoma* by the absence of false gill openings made by outer duplications of the true gill openings, and the position of the gill slits which are lateral or only partially ventral. Gill slits vertical or nearly so, the interspace but little, if any, narrower than their length. Body small, rounded, with rather small head and weak jaws; dorsal fin inserted behind gill openings.

Species not numerous, one in the Mediterranean, others Asiatic.

#### Key to the Philippine species of *Cæcula*.

*a*<sup>1</sup>. Depth contained 25 to 30 times in length..... *C. mindora*.  
*a*<sup>2</sup>. Depth contained 18 times in length..... *C. taylori*.

#### *Cæcula mindora* Jordan and Richardson.

*Cæcula mindora* JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 239, fig. 4.

*Sphagebranchus mindora* WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 322.

Depth 25 to 30 in length, head 7.4 to 7.7, and 2.6 to 2.8 in trunk; tail a little longer than head and trunk together; eyes very small, 17 to 25 in head, about 3.5 in the slender, pointed snout, which is about 7 in head; mouth very wide, 2.5 in head and extending far beyond eyes which are at the end of the first third of gape; the distance between origin of dorsal and gill openings is one-fourth the length of head; vertical fins moderately developed; teeth small, sharp, recurved, in one row;

those on vomer much larger, six to ten in number; intermaxillary plate with three to five large stout teeth in a transverse series, separated from the rest by a wide shallow cross notch into which tip of mandible fits; gill openings lateral, vertical or nearly so, separated by an interspace of their own length.

Color above lateral line uniformly finely punctulated dark brown or grayish brown; lower half yellow or pale, almost a sharp line separating upper from lower color on tail; scattered punctulations extending a short distance below lateral line on trunk; top and tip of snout blue-black; under jaw specked and splashed with bluish black; lateral line with a series of small, more or less stellate whitish spots about the size of eye, or pores in round yellow spots; pores on head in smaller spots which form a transverse band on vertex.

This eel reaches a length of nearly 400 millimeters. It is known only from a specimen from Mindoro Island, and one from Waigeu Island, which was caught above the mouth of a river, in fresh water.

*Cæcula taylori* sp. nov. Plate 6, fig. 2.

Depth 18.2 in length, head 8.86, and 3 in trunk; tail a little longer than head and trunk together, their length being 82.2 per cent of that of tail; the small protuberant eyes in advance of middle of gape and 1.51 in snout and 14.8 in head; gape wide and 3.08 in head; the distance between the origin of dorsal and a vertical drawn from dorsal to gill openings is contained 9.25 times in head; vertical fins very low, height of dorsal more than 7 in depth; ventral higher than dorsal and twice as high anteriorly as posteriorly; its origin is separated from anal opening by a broad interspace; dorsal and anal end opposite each other, close to tip of tail; vertical gill openings separated by an interspace equal to their length; teeth small, sharp, recurved, in single rows, about thirty of uniform size in each maxilla and about twenty-two on each side in lower jaw; the first two pairs in mandible much stouter than the others; three rather small teeth on intermaxillary plate, their arrangement shown in the figure; a row of five widely spaced teeth on vomer,

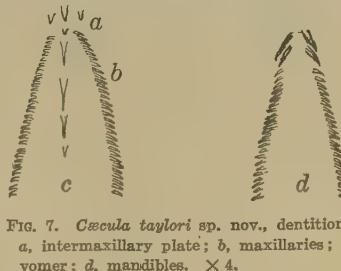


FIG. 7. *Cæcula taylori* sp. nov., dentition; a, intermaxillary plate; b, maxillaries; c, vomer; d, mandibles.  $\times 4$ .

the first three much larger than any of the other teeth, the last one very small.

A small, heavy-bodied insignificant eel with weak, narrow, sharp-pointed jaws and rounded tail that tapers to a sharp point likewise. Ground color pale to whitish, apparently in life clear light yellow; dorsal region dark olivaceous brown, made so by the coalescence of innumerable dots which extend down the sides below the conspicuous lateral line and over lower jaw.

Here described from the type and only specimen, collected in January, 1922, in Cabatoan River near Iba, Zambales, by Mr. H. R. Montalban. It is close to *Cæcula mindora* of Jordan and Richardson, and to *Cæcula macrodon* (Bleeker), but differs from them both in bodily proportions and dentition.

Its dimensions are as follows: Length, 164 millimeters; depth, 9; head, 18.5; trunk, 55.5; tail, 90; eye, 1.25; gape, 6.

I take pleasure in naming this species for Mr. E. H. Taylor, student of Philippine reptiles and amphibia.

#### MORINGUIDÆ

Body slender and more or less cylindrical, tail much shorter than rest of body. Pectorals small, vestigial, or altogether lacking; dorsal and anal fins small and low, confined to tail, and often reduced to a small fin around tip of tail. Head small, usually depressed, with posterior nostrils in front of eyes, which are small and usually covered with skin; mouth small, weak, with small, uniserial teeth, lower jaw projecting; gill openings usually narrow, inferior; heart located far behind gills.

Small eels of the tropical seas of both hemispheres, the genera closely related and the species often difficult to distinguish. The family is easily recognized by its remarkably wormlike appearance, in connection with its weak head, elongated trunk, and very short tail.

This small group of peculiar eels is probably related most nearly to the morays, but its relationships are not certain.

#### *Key to Philippine genera of the Moringuidæ.*

*a<sup>1</sup>.* Dorsal and anal higher and with visible rays anteriorly and posteriorly; lower, or a mere fold of skin in the middle..... *Moringua*.

*a<sup>2</sup>.* Vertical fins reduced to a low fold and developed only at tip of tail. *Aphthalmichthys*.

## Genus MORINGUA Gray

*Moringua* J. E. GRAY, The Zool. Misc. (1831) 9.  
*Rataboura* J. E. GRAY, Ill. Ind. Zool. (1831) 95.

Body wormlike, depth 30 to 60 in length, dorsal and anal well developed around tail, then reduced to a low fold or ridge of skin; farther forward again developed so that they are as high as or higher than on tail, with visibly developed rays; pectorals may be vestigial, but are usually well developed though small; teeth acute, in one row on jaws, uniserial or irregularly two rowed on vomer.

This genus is easily distinguished by the peculiar character of the dorsal and anal fins, each being divided into two parts, separated by a considerable interspace.

Key to Philippine species of *Moringua*.

- a<sup>1</sup>*. Intermaxillaries with two rows of teeth; depth less than 35 in length. *M. robusta*.
- a<sup>2</sup>*. Intermaxillaries with one row of teeth; depth over 50 in length; distance of anal from anus four-fifths the length of head..... *M. cagayana*.

*Moringua robusta* sp. nov. Plate 7.

Depth 3.5 in head and 34.4 in total length, head 5.16 in trunk and 9.77 in whole length; tail shorter than head and trunk together, being contained 1.4 in trunk alone and is almost 37 per cent of total length; eyes small, 26.8 in head and 2.4 in the small, rather sharp snout which is  $11\frac{1}{6}$  in head; mouth extending beyond eye, 6.7 times in head, lower jaw very slightly projecting; distance of origin of anal from anus 4.46 in head; origin of dorsal behind that of anal, the difference being a trifle more than 2.3 in head, while distance from anus to dorsal is a very little more than 1.5 in head, being almost exactly two-thirds the length of head; pectorals, though short, are broad and well developed,  $8\frac{3}{8}$  in head, with nine rays, base equal in breadth to length of snout; teeth all small, pointed, recurved; maxillary teeth tiny, eighteen to twenty in a single row; nine small teeth in outer row on intermaxillary, with two or three slightly larger ones in inner row on each side; seven or eight teeth on vomer; about twenty small teeth on each side of lower jaw.

This eel is noticeable for its stout body, which is slightly broader than its greatest depth, and for its long head, which terminates in noticeably small, weak snout and jaws; dorsal and anal fins originate as a mere fold but soon become comparatively

well developed with plainly visible rays, their height a little less than one-third that of tail beneath; they are reduced to folds of skin farther back but become much larger, a little less than two-thirds the length of head from tip of tail, and unite with caudal to form a somewhat spatulate fin; posterior nostrils in front of middle of eyes and very close to them; both anterior and posterior nostrils with distinct, whitish, slightly elevated rims; pectorals immediately behind and somewhat higher than gill openings.

Color dark brown above, light brown below, throat and belly paler to grayish brown; the terminal dorso-caudal-anal fin very dark brown with paler margin.

This eel is close to *Aphthalmichthys macrocephalus*, and to *Moringua floresiana*, but differs markedly from the first in the development of the vertical fins and is quite unlike Bleeker's figure; the dentition is different from that of either of the above-named species, while its proportions are altogether different from those of *M. floresiana*.

Here described from the type and only specimen, Bureau of Science collection No. 9664, from Dumaguete, Oriental Negros. Its dimensions are as follows: Length, 655 millimeters; head, 67; trunk, 346; tail, 242; depth, 19; breadth, 20; eye, 2.5; gape, 10; snout, 6; pectoral, 8.

This species is distinguished from *Moringua microchir* Bleeker by its greater relative bulkiness, longer tail, different position of dorsal and anal, and altogether different dentition.

*Moringua cagayana* Seale. Plate 8.

*Moringua cagayana* SEALE, Philip. Journ. Sci. § A 4 (1909) 493.

Depth about 4 in head and 51.3 in total length; head 7.75 in trunk and 13.1 in total length; trunk longer than head and tail together, being more than 0.59 of total; tail almost exactly one-third of total length; eyes small, 18.4 in head and twice in snout; cleft of mouth extends an eye diameter beyond eye and is 4.7 in head; pectorals approximately equal to distance from tip of snout to rear margin of eye. Origin of anal about four-fifths the length of head behind anus; origin of dorsal still farther back, its distance from anus being equal to that from tip of snout to tip of pectorals.

A single row of fragile, sharp-pointed, recurved teeth in each jaw and five pairs of larger teeth on intermaxillary plate; nine teeth on vomer, arranged in an irregular double row as shown in the figure.

A greatly elongated and slender eel with a long head, projecting lower jaw, and large and baggy buccal cavity; tubules to anterior nostrils very short, forming covers to nostrils, the openings minute; posterior nostrils much larger, open, each with a small flap at the forward margin; dorsal and anal fins high and well developed near their origin and for a distance about equal to that from tip of snout to tip of pectorals; then follows an interspace of greater extent, the fins reappearing near tip of tail and uniting with caudal fin to form a broad, paddle-shaped organ.

Color in alcohol brown, with a very dark brown line along middle of back; last half of tail blackish brown as are the dorsal and anal fins; pectorals hyaline; body everywhere punctulate with minute dark dots.

The type and only specimen, Bureau of Science collection No. 1621, was caught in the sea near Cagayan, Mindanao, September 13, 1907, by Mr. Alvin Seale. It is a female, approximately 616 millimeters in length, with the body wall distended to paper thinness by the mass of eggs evidently about ready for extrusion, and giving a yellow color to the distorted abdomen. In common with many other fishes, the ovaries in this species extend much farther posteriorly than the anal opening; beginning very far forward, the ovaries are approximately 400 millimeters long while the trunk, from gill opening to anus, is only about 364 millimeters long.

Owing to the softness and the distortion of the abdomen, measurements can only be approximate, but the characters are sufficiently defined to show this to be a unique species.

#### Genus APHTHALMICHTHYS Kaup

*Aphthalmichthys* KAUP, Arch. Naturg. 22 (1856) 68; Cat. Apod. Fishes Brit. Mus. (1856) 105.

Body scaleless, wormlike, its greatest depth from 35 to 100 in length. Dorsal and anal fins rudimentary, inconspicuous, threadlike folds, but little developed except around tip of tail; pectorals wanting or vestigial and barely perceptible; eyes rudimentary and more or less covered by thick skin; lower jaw

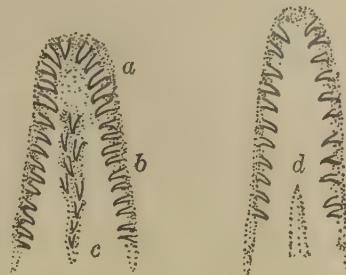


FIG. 8. *Moringua cagayana* Seale, dentition; *a*, intermaxillaries; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 5$ .

equal to or longer than upper jaw; teeth weak, pointed, one rowed, on palatines, nasal, vomer, and intermaxillaries; tail much shorter than body; heart placed far behind gills.

Small and usually very slender eels, noticeable for the slight development of the fins and the very short tail. They are found buried in mud, sand, or gravel, in salt or brackish water on reefs along the coast or in river mouths, and they often enter fresh-water streams. They are abundant in the East Indies and are distributed from India to Hawaii and the South Sea Islands, and from Japan to the northern coast of Australia.

These insignificant eels astonishingly resemble certain worms; the species are difficult to distinguish, the characters altering greatly with age.

*Key to the Philippine species of Aphthalmichthys.*

- a<sup>1</sup>.* Head less than 10 in length.
- b<sup>1</sup>.* Head 8.5 to 9.9, depth 32 to 43 in length..... *A. macrocephalus.*
- b<sup>2</sup>.* Head 8.92, depth 28½ in length..... *A. lumbricoides.*
- a<sup>2</sup>.* Head more than 10 in length.
- c<sup>1</sup>.* Head 10 to 13.3, depth 35 to 47 in length..... *A. abbreviatus.*
- c<sup>2</sup>.* Head 14 to 22, depth 55 to 95 in length..... *A. javanicus.*

*Aphthalmichthys macrocephalus* Bleeker. Plate 9, fig. 2.

*Aphthalmichthys macrocephalus* BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 165; Atlas Ichth. Muræn. 4 (1864) 17, pl. 3, fig. 2; PETERS, Monatsber. Akad. Wiss. Berlin (1868) (1869) 275.

*Moringua macrocephala* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 195; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 341.

Depth 32 to 43 in length, head 7.7 to 9.9, and 4.23 to 5.8 in trunk (4, Jordan and Seale); tail 2.12 to 2.18 in head and trunk together in my specimens (1.7 to 2.3, Weber and Beaufort); the

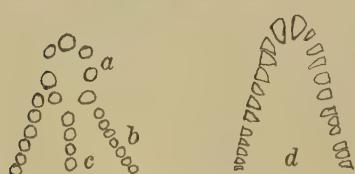


FIG. 9. *Aphthalmichthys macrocephalus* Bleeker, dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 4$ .

minute eyes 17.3 to 22 in head and 2 to 2.5 in snout; mouth relatively large, lower jaw projecting as in nearly all Moringuidæ, gape 4 to 4.72 in head and extending well beyond eyes; teeth conical, sharp, pointing backward; six to eight on each maxillary, with about eight stouter teeth on intermaxillary

plate; four to five small teeth in a single row on vomer, the anterior tooth largest; ten or twelve teeth on each side of lower jaw, the anterior ones largest.

A robust, wormlike eel, strongly resembling the giant Philippine species of earthworms. Pectorals may be altogether absent or may be present but minute, their length about equaling the diameter of an eye; vertical fins mere seamlike folds of skin, only developed at the end of the tail where they join with the caudal to form a short truncate fin; the distance between anus and origin of anal fin is 1.5 to 1.9 in head; origin of dorsal may be opposite or behind origin of anal; in the latter case the difference between the origin of the two fins is contained 5 to 10 in head. Jordan and Seale state the color in life of a specimen obtained at Pago Pago, Samoa, to be nearly uniform light pinkish brown; the head very clear translucent rosy red; the caudal more orange.

The color in alcohol is dull leaden to brownish above; paler beneath, varying from bluish to yellowish or whitish.

I have examined four excellent specimens, obtained at Alaminos, Pangasinan, by Mr. Eugenio Fénix. They vary in length from 200 to 385 millimeters. In color and general habit of body they contrast strongly with the *Ascaris*-like species, *abbreviatus* and *javanicus*. Another specimen, obtained by Mr. Montalban at Iba, Zambales, is 350 millimeters long, and in life was pinkish brown.

Peters's specimen was collected by Jagor at Legaspi, Albay. This little-known eel attains a length of 700 millimeters and is found from the shores of British India to Samoa. Like its congeners it is a shore dweller, living in the mud around the mouths of streams.

Since the above was printed I have received 5 specimens, from 51 to 138 millimeters in length, from Mr. Angel Villanueva, who collected them at Luboc beach, Lapaz, Iloilo Province, Panay.

*Aphthalmichthys lumbricoideus* (Richardson).

*Moringua lumbricoidea* RICHARDSON, Voyage Sulphur, Ichth. (1844) 113, pl. 56, figs. 7-11; GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 91, pro parte; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 773; JORDAN and SEALE, Bull. U. S. Bur. Fisheries 26 (1906) (1907) 7.

I have not seen this species, but Jordan and Seale had a specimen from Cavite and two from Negros which they named *Moringua lumbricoidea*. An examination of Richardson's figure shows that his specimen lacked the essential character of *Moringua* as distinguished from *Aphthalmichthys*, while his description of the fins is that of the latter genus. His figure also

shows *lumbricoideus* to have the dorsal and anal fins much better developed than they are in *macrocephalus*.

The following is Richardson's original description:

In *M. lumbricoidea* the gill openings are small, lateral, and on their posterior edge there is a minute fold, which is perhaps the vestige of a pectoral fin. The head is small, conical, with a moderately acute, but not pointed, snout, projecting very slightly beyond the lower jaw. One nostril opens at the inner angle of the eye, and the other near the end of the snout. A series of large pores runs along the snout on each side and across the nape. The throat is plaited and distensible. Teeth acute, short, subulate, inclined backwards, in a single series, on both jaws and along the vomerine line. The lower teeth of *M. linearis* are described as blunt (Gray 1. c.). The body is very nearly cylindrical, and retains its thickness equably from the gill opening to some distance beyond the anus.

The rest of the tail tapers slightly, and is a little compressed. The skin is smooth and even throughout, no scales are visible, and no lateral line. The dorsal and anal fins are highest at the end of the tail, where they unite. The anal runs forward to the anus, gradually lowering in height to a mere line. The dorsal cannot be traced so far forward. The thickness of the integument prevents the fine rays of these fins from being readily counted, but at the tip of the tail there are fifteen rays, a little thicker, which may be considered as a caudal. The general color is pale reddish-brown, gradually fading to white towards the belly, and finely sprinkled with darker dots.

#### DIMENSIONS

	Inch.
Tip of snout to end of tail	10.00
Tip of snout to gill-opening	1.12
Tip of snout to anus	6.75

#### *Aphthalmichthys abbreviatus* Bleeker.

*Aphthalmichthys abbreviatus* BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 163; Atlas Ichth. Muræn. 4 (1864) 17, pl. 1, fig. 1; JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 877.

*Moringua abbreviata* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 92; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 773; JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 241; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 341.

I refer here nineteen small wormlike eels, having a remarkable resemblance to the parasitic nematodes belonging to the genus *Ascaris*. They were collected at Dumaguete, Oriental Negros, and vary in length from 125 to 195 millimeters, and in depth from less than 3 to about 5 millimeters.

Depth 35 to 47 in length; head 10 to 11.5 in length in my material (to 13.3, Weber and Beaufort) and 6 to 7.5 in trunk; tail 2.8 to 3.2 in length of head and trunk together; distance from anus to origin of anal fold  $1\frac{1}{2}$  to  $2\frac{5}{6}$  in length of head. The head is longer in these than in those described by authors,

but in all this group older and larger specimens have the trunk longer proportionately.

This species may be distinguished from *Aphthalmichthys javanicus* by its stouter habit of body and by the much shorter distance between the anus and the origin of the fold of skin which represents the anal fin. In other respects the description of *javanicus* might serve for this species.

Found throughout the East Indies, ranging northward to the Riu Kiu Islands, and southeast to the Fiji Islands. Previous Philippine records are from Ticao Island, and from southern Negros.

A shore- and reef-dwelling species, burrowing in mud, sand, and gravel, and entering the mouths of streams.

#### *Aphthalmichthys javanicus* Kaup.

*Aphthalmichthys javanicus* KAUP, Arch. Natur. 22<sup>1</sup> (1856) 68; Cat.

Apod. Fishes Brit. Mus. (1856) 105, pl. 14, fig. 71; BLEEKER, Atlas Ichth. Muræn. 4 (1864) 16, pl. 2, fig. 2; JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 877.

*Moringua javanica* GÜNTHER, Fische d. Südsee 3 (1910) 405; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 342, fig. 164.

Body exceedingly wormlike in color and in general appearance; no pectorals; dorsal and anal reduced to mere threadlike folds and only developed, and then but slightly, around the tip of the rather blunt tail; origin of anal about the length of head or a little more from anus; origin of dorsal approximately opposite anal; lateral line prominent, with numerous pores, beginning on occiput or halfway between eyes and gill slits; head small, weak, depressed, lower jaw projecting and relatively much stouter; cleft of mouth extending far behind eyes, which are very small, rudimentary, and covered with thick skin; anterior nostrils with short tubes, the posterior ones immediately in front of eyes, their rims with a flap on anterior side; teeth in a single row, pointed, recurved, the front ones much the larger and stronger.

A specimen from Dumaguete, Oriental Negros, has the following dimensions: Length, 387 millimeters; depth, 6.5; head, 26; trunk, 242; tail, 110; cleft of mouth, 4.5; distance from anus to origin of anal, 31; eye 26 in head.

In a Philippine specimen obtained from the Manila Normal School collection, exact locality unknown, the dimensions are as follows: Length, 333 millimeters; depth, about 6; head, 23; trunk, 215; tail, 92; snout, 3.5; cleft of mouth, 4.5; origin of anal 25 millimeters behind anus; eye minute, about 30 in head.

Depth 55 to 95 in length, head 14 to 22, and 7.5 to 13 in trunk; tail 2.5 to 3.1 in length of head and trunk together; cleft of mouth 4.5 to 5.5 in head.

Color pale, like that of *Ascaris*, to a brownish earthworm hue. Abundant in the East Indies, found in southern Japan, and widely distributed among the South Sea Islands. According to Günther it reaches a length of 3 feet (nearly 1 meter).

Burrowing in sand, gravel, and mud along the seashore, especially near the mouths of fresh-water streams.

#### MURÆNIDÆ

##### MORAYS

This group includes large and powerful eels, with cylindrical or more or less compressed and elongate to very elongate body. They are distinguished at once by their thick, leathery, scaleless, often beautifully colored skin, their lack of pectorals, and their small, lateral, widely separated, nearly circular gill openings; the latter in some become nearly horizontal slits. Dorsal and anal fins confluent with anal and usually covered with thick skin; they may be well developed or reduced to a vestige at end of tail. Cleft of mouth extends behind eye; the jaws are usually narrow and often so curved and the mouth so filled with large knifelike or canine teeth that they cannot be closed. Teeth in one or more series in jaws, on intermaxillary plate, and on vomer; they may be granular, molarlike, conical, or compressed, pointed, depressible, and fanglike. Anterior nostrils in a tube near tip of snout; posterior nostrils before or above eye and sometimes with an elevated rim or a short tube.

The skeleton shows the Murænidæ to be a degenerate type, farthest removed from the more typical fishes from which the eels developed. Those without fins are the simplest in structure, but this is a mark of degradation and they are farthest from the primitive stock.

A large family with ten or twelve genera and perhaps a hundred species or more, found in the tropical and subtropical seas of both hemispheres. They abound about coral reefs, and in pools on exposed tide flats where many of the species burrow in the coral sand with startling rapidity when disturbed.

The morays are voracious and quarrelsome fishes and include some of the largest of the eels. Many of the species are very beautiful, with rich variegated colors in bands, stripes, or mottled and spotted. One may see them moving about and

searching every crevice, or more often discover them coiled under rocks from which they strike at passing fish just as a snake does at its prey. When provoked and cornered they are formidable enemies and inflict terrific wounds, sometimes driving a boatload of fishermen overboard.

According to Calmette,<sup>9</sup> some of the Murænidæ are poisonous, being provided with poison fangs and glands.

The poison apparatus consists of a pouch situated above the membrane of the palate, which may contain one-half c.c. of venom. The teeth are not pierced by a central canal, and the venom flows between them and the mucus membrane of the palate, which forms a sheath.

While the morays are used more or less for food and, in fact, some are highly prized by epicures, they are apt to be oily and rather indigestible, so that the flesh of large old individuals of some of the species is unwholesome when indulged in freely.

The Moros apply the common Malay name, *indong* or *indang*, to all morays; this name is also current among the Visayans, but very large ones are called *panañglitan*; in the Visayan dialect of Samar and Leyte they are called *hagmañg* and in Cebuano Visayan *hañgit*, while at Iloilo they are known as *ogdoc*; other Visayan names are *haoig*, *taguibós* and *taguibolos*; the Tagalogs use the name *malabanós*, while they distinguish the large and fiercely biting kinds as *payanñgitan*, a name evidently the same as the Visayan one for similar morays. Such names as *taguibos* are not only very strongly accented on the last syllable but the accentuation is emphasized by being drawled as though the speaker were loth to let go the word.

*Key to the Philippine genera of Murænidæ.*

- a<sup>1</sup>.* Vertical fins well developed; origin of dorsal on head or immediately behind gill openings.
- b<sup>1</sup>.* Teeth more or less obtuse, molarlike or granular..... *Echidna*.
- b<sup>2</sup>.* None of the teeth molarlike or granular.
- c<sup>1</sup>.* Tail 1.5 to 2 times as long as head and trunk together; anterior nostrils in a simple tube..... *Evenchelys*.
- c<sup>2</sup>.* Tail equal to or a little longer or shorter than the rest of body.
- d<sup>1</sup>.* Anal always present and unmodified.
- e<sup>1</sup>.* Trunk very slender, elongate; depth 40 to 55, head 12 to 17 in length..... *Pseudechidna*.
- e<sup>2</sup>.* Depth less than 30, head less than 12 in length.... *Gymnothorax*.
- d<sup>2</sup>.* Anal absent or only a trace at tip of tail..... *Anarchias*.
- a<sup>2</sup>.* Vertical fins reduced to a rudiment at tip of tail or altogether wanting.

*Uropterygius.*

<sup>9</sup> Venoms (1908), English translation.

## Genus ECHIDNA Forster

*Echidna* FORSTER, Icones Ineditae; Bibliotheca Banksiae (1777) 181.

Elongate compressed murænids, with the dorsal profile strongly arched, and with blunt, conical, granular or molarlike teeth, their form, number, and arrangement often changed with age; eyes small, covered by skin; dorsal confluent with anal, both covered by thick skin; gill openings small, in the middle of the height of body.

These morays are found about the shores and reefs of tropical seas, and represent the highest degree of specialization of the group. The genus is well distinguished by its blunt teeth, which indicate that crustaceans and mollusks are the chief food.

*Key to the Philippine species of Echidna.*

- a<sup>1</sup>.* Tail twice or more than twice in head and trunk; dark brown, with thirty to over one hundred narrow white rings..... *E. zebra*.
- a<sup>2</sup>.* Tail equal to, one-third longer, or a little shorter than head and trunk.
- b<sup>1</sup>.* Body conspicuously banded or spotted.
- c<sup>1</sup>.* Twenty-three to twenty-nine broad dark brown bands on body.
- E. polyzona*.
- c<sup>2</sup>.* Two rows of large stellate spots on each side; interspaces paler with many fine lines and spots..... *E. nebulosa*.
- b<sup>2</sup>.* Color uniform dark brown or brown marbled with darker; no conspicuous bands or rows of spots.
- d<sup>1</sup>.* Color uniform with a white spot on upper lip and a longer one on lower lip near angle of mouth..... *E. rhodochilus*.
- d<sup>2</sup>.* Body marbled; no white blotch at angle of mouth.
- e<sup>1</sup>.* Teeth on intermaxillary in a semicircle with two stouter teeth in middle..... *E. delicatula*.
- e<sup>2</sup>.* Teeth on intermaxillary in five rows, the inner ones largest.
- E. amblyodon*.

*Echidna zebra* (Shaw).

*Gymnothorax zebra* SHAW, Nat. Misc. 9 (1797) pl. 322.

*Echidna zebra* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 81, pl. 27, fig. 1; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 106, pl. 20; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 345, fig. 168; FOWLER, Proc. Acad. Nat. Sci. Phila. 64 (1912) 27.

The depth is contained  $20\frac{1}{2}$  in length; the thick, heavy, short head is contained  $10\frac{2}{3}$  in total length,  $6\frac{2}{3}$  in trunk, and 3 in tail; the last named is short and strongly compressed posteriorly; its length is not quite 28 per cent of the total length and is contained  $2\frac{5}{9}$  in head and trunk; eyes rather large and slightly elliptical, their longest diameter contained 8 in head and fifteen-nineteenths of the short blunt snout, which projects well beyond tip of mandible; lower jaw curved so that the mouth cannot be

closed completely and the gape extends far behind eyes, its length 2.4 times in that of head; the teeth on maxillaries in two short rows and much the smallest, the remaining teeth all being broad, smooth, and granular or molarlike; on vomer is a pear-shaped group of large teeth which is broadly connected with a rounded group of similar teeth on the intermaxillary plate so that the whole roof of mouth is studded with teeth, the central ones being the largest; mandible has three or four irregular rows of teeth, those of inner row being the largest; head deep, compressed, and much swollen on occiput; dorsal and anal fins concealed by the smooth, thick, very tough skin and almost obsolete except near tip of tail; dorsal very low, its height only one-fourth or one-fifth that of trunk.

Color in alcohol dark reddish to chocolate brown, with over seventy narrow white rings, each faintly bordered by a darker or blackish edging; the rings may be divided, fragmentary, or broken up into spots, but most of them are complete.

The above description is that of a fine specimen, 640 millimeters long, obtained at Nasugbu, Batangas, November 25, 1922. Its other dimensions are as follows: Depth, 30 millimeters; head, 60; tail, 180; eye, 7.5; gape, 2.4.

According to Weber and Beaufort the proportions are as follows: "Height 17-21; head 8.6-9.75, 4.8 to about 5.5 in trunk. Tail nearly twice to more than twice in head and trunk. Eye 10-12.5, 1.6 to twice in snout. Snout more or less than 7 in head. Cleft of mouth 2.7 to 3.5 in length of head."

The color in life is dark reddish or purplish brown, with from thirty to more than one hundred narrow white, pale yellowish, or golden rings, each bordered by a darker edging than the general body color.

This is the first authentic record from the Philippines of this handsome, easily recognized, and particularly snaky-looking eel.

As there is apparently no such locality as Muscat Cove in the Philippines, neither the Coast and Geodetic Survey nor the Philippine Census Bureau having any knowledge of such a place, I cannot accept Fowler's record cited above.

This eel reaches a length of 1,250 millimeters or more, and is very widely distributed. It was originally described from a specimen obtained in Sumatra, but is now known from the Red Sea and the east coast of Africa to the Hawaiian Islands and throughout Polynesia.

*Echidna polyzona* (Richardson).

*Muræna polyzona* RICHARDSON, Voyage Sulphur, Fishes 3 (1844) 112, pl. 55, figs. 11-14.

*Echidna polyzona* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 81, pl. 24, fig. 3; JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 241; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 346, fig. 169.

*Echidna tritor* VAILLANT and SAUVAGE, Rev. et Mag. Zool. III 3 (1875) 287.

*Echidna zonata* FOWLER, Proc. Acad. Nat. Sci. Phila. (1900) 495, pl. 18, fig. 2; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 108, fig. 31.

*Echidna zonophæa* JORDAN and EVERMANN, Bull. U. S. Fish Comm. 22 (1902) (1904) 167; Bull. U. S. Fish Comm. 23 (1903) (1905) 109, pl. 21.

*Echidna leihala* JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1904) 428, fig. 9; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 109, fig. 32.

*Echidna vincta* JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1904) 429, fig. 10.

*Echidna obscura* JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1904) 430, fig. 11; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 107, fig. 30.

*Echidna psalion* JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1904) 431, fig. 12; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1905) (1907) 106, fig. 29.

The variability of this eel is attested by the numerous names which have been applied to its various color phases by different authors.

Depth in total length 15 to 18, head 6.5 to 8.3; head and trunk equal to or a little shorter or longer than tail; eye 8 to 10 in head and a little more than once to twice in snout; gape 2.5 to 3.2 in head, extending well beyond eye.

Body compressed, the tail strongly so and tapering posteriorly; head narrow, strongly elevated between eyes and gill openings, which are small horizontal slits about the midline of body; lower jaw curved, so that not all teeth touch, this fact concealed by the thick fleshy lips; teeth varying much with age, those on maxillary small, usually in two rows; those on vomer large, close-set molars, increasing in size posteriorly; those on intermaxillary plate form an outer series more or less sharp, inclosing three much larger molar teeth extending down the middle; sometimes the molars are more numerous and form an irregular group; teeth on lower jaw in a double row, which becomes a triple row posteriorly in old specimens, those in outer row somewhat smaller; origin of dorsal before gill openings.

Color variable; normally gray or whitish to yellow or brown, with from twenty-three to twenty-nine broad dark brown bands which are continued on fins, the body color appearing as very narrow pale rings which merge along throat and anterior portion of trunk; the dark bands may be irregular, partial, or they may nearly disappear except on end of tail, when the color appears as reticulations or marblings.

There is a single small specimen, 159 millimeters long, in the Bureau of Science collection, taken at Calapan, Mindoro, and I have examined another one, 165 millimeters long, collected at Nasugbu, Batangas, by students of the College of Agriculture. It has also been recorded from Calayan, by Jordan and Richardson.

A shore and reef inhabitant, reaching a length of 550 millimeters, and occurring from the Red Sea to Formosa, Hawaii, and the Paumotu Archipelago.

**Echidna nebulosa (Ahl).** Plate 10, fig. 3.

*Muræna nebulosa* AHL, Dissert de Muræna et Ophichtho 3 (1789) 5, pl. 1, fig. 2.

*Muræna ophis* RÜPPELL, Atlas Reise Nördl. Afrika (1828) 116, pl. 29, fig. 2.

*Muræna variegata* RICHARDSON, Voyage Erebus and Terror, Fishes (1844-48) 94, pl. 47, figs. 1-5 and 11-16.

*Echidna variegata* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 80, pl. 24, fig. 2.

*Muræna nebulosa* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 130, Fische d. Südsee 3 (1910) 423; DAY, Fishes of India (1878-88) 673, pl. 172, fig. 2.

*Echidna nebulosa* JENKINS, Bull. U. S. Fish Comm. 22 (1902) (1903) 429; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 110, pl. 1; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 348, fig. 170.

Depth 16 to 21 in total length; head 9.65 to a trifle more than 10 in total length, and from 3.25 to a little more than 4 in trunk; head and trunk together equal to tail, or the latter may be a little shorter or a little longer than rest of animal; eye 8 to 12.5 in head, and from 1.6 to 2.5 in snout, which is 5 to nearly 6 in head; the wide mouth  $2\frac{2}{3}$  to 3.5 in head; origin of dorsal in advance of gill openings; maxillary teeth in one row, very small, bluntly conical or granular; intermaxillary plate with two large blunt teeth in the middle, surrounded by a semicircle of about a dozen similar teeth, some of which are smaller than the two inner ones; vomer with two parallel rows of similar teeth nearly as large, six to ten in number; lower jaw with teeth in two rows in

old specimens, the inner row larger; young individuals have two rows in front part of jaw only; teeth near symphysis larger than the rest; all teeth in young specimens more or less pointed and recurved, and a few such occur in the jaws of older ones.

Color in alcohol more or less yellowish, brownish, or whitish with two rows of large, black, irregular, dendritic or stellate spots, one along back and dorsal fin and one along lower half of body, each spot including one to three white or yellow spots; the spots on lower half often connected by black bands crossing undersurface of body; the spaces between the larger spots thickly sprinkled with fine irregular lines and spots.

I have examined eight specimens; one from Guam, three from Leyte, two from Mindoro, and two from Iba, Zambales.

They range in length from 226 to 440 millimeters. One of those from Leyte is a good example of what often befalls eels, and likewise illustrates their power of regeneration. Its tail is only 31 per cent of the total length and but a trifle more than four-sevenths of the length of the trunk; instead of tapering, at least half of it has evidently been bitten off and healed over, the caudal fin being entirely absent.

This common and handsome eel is said to be a savage biter and is feared by the fishermen in some regions. In the Visayas it is called *hagman* or *hagmang*. It is said to reach a length of 5 feet (about 1.5 meters).

This species was obtained by the Challenger Expedition on reefs near Cebu; it has been recorded by Jordan and Seale from southern Negros, and from Calayan Island, north of Luzon, by Jordan and Richardson.

It occurs from Madagascar and along the east coast of Africa to the Red Sea, eastward to China, the Philippines, on to Guam and Hawaii, south to Australia, and everywhere throughout the South Sea Islands.

**Echidna rhodochilus Bleeker.** Plate 10, fig. 4.

*Echidna rhodochilus* BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 247; Atlas Ichth. Muræn. 4 (1864) 79, pl. 23, fig. 4; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 350.

Depth 16 to 19 in total length, head 10 to 11 (8 to 10, according to Weber and Beaufort) and 3.6 to  $4\frac{1}{6}$  in trunk (3 to 3.6, Weber and Beaufort); head and trunk together one-sixteenth to three-sixteenths shorter than tail; eye 8.5 to  $10\frac{2}{3}$  in head and about 1.8 in the rather short, blunt, and rounded snout, which is 6 or a little less than 6 in head; mouth large, reaching far behind eyes,

2½ to 2¾ in head; two rows of small, sharp-pointed maxillary teeth, thirteen to fifteen in each row, those of inner row the larger; intermaxillary teeth larger, about eighteen in outer row with twelve or thirteen much larger ones forming a group covering the plate; vomer with about fifteen teeth, larger than those of maxillaries and in an irregular single or double row; a single row of ten to fourteen teeth on posterior portion of mandible, with from seven to nine pairs of larger teeth on each side at forward end.

A small snakelike eel of insignificant appearance and reminding one of *Uropterygius concolor*, but distinguishable at a glance from all other morays by the elongate white spot below eye on upper lip and a similar but longer one on lower lip, which extends backward to angle of mouth. Color in other respects uniform dark brown or grayish brown in alcohol. The pores on upper and lower jaws white. Dorsal low, inconspicuous except posteriorly, its origin well behind gill openings.

Here described from a specimen 210 millimeters long, from Masbate, Bureau of Science collection No. 1087, and two specimens sent me by Mr. H. R. Montalban, who obtained them in October, 1921, from a fish trap in the mouth of a river near Iba, Zambales. One is a female 350 millimeters long, ready to spawn, the other a male 320 millimeters long, likewise ready for the reproductive act.

Through the courtesy of the Department of Zoölogy of the College of Agriculture at Los Baños I have obtained, as this goes to press, two more specimens, 185 and 195 millimeters long. They were found in holes in a stump in sea water at Palanas, Lemery, Batangas Province, Luzon, January 5, 1923.

This rare species was described by Bleeker from Buru Island, in the Moluccas, and from Rotti Island, southeast of Timor. Weber and Beaufort have specimens also from Simalur and Karakelang Islands.

#### *Echidna delicatula* (Kaup).

*Poecilophis delicatulus* KAUP, Cat. Apod. Fishes Brit. Mus. (1856) 102.

*Echidna delicatula* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 78, pl. 23, fig. 3; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 772 (Negros); Bull. U. S. Bur. Fisheries 25 (1905) (1906) 204; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 350.

*Echidna kishinouyei* JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 885, fig. 21.

*Echidna trossula* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 203, fig. 8.

Depth 14.5 to 17.4 in total length, head 7.4 to more than 9, and about 3 in trunk; head and trunk together equal to or somewhat shorter than tail; eye 8 to 10 in head and 1.5 to 2 in snout, which is from 5 to more than 6 in head; mouth large, its gape 2.2 to 3 in head; dorsal begins about three-fourths the length of head from snout and is comparatively high, about one-third

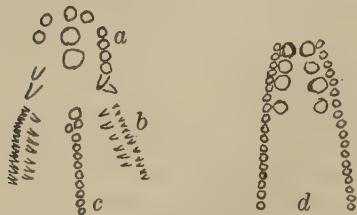


FIG. 10. *Echidna delicatula* (Kaup), dentition; a, intermaxillary plate; b, maxillaries; c, vomer; d, mandibles.  $\times 4$ .

the depth of body; anal nearly as high; two rows of teeth on maxillaries, the outer row of about twelve minute teeth, the much shorter inner row of six to eight very much larger sharp teeth; ten to twelve large stout recurved teeth in a row around intermaxillary plate with two still stronger teeth in a row in the middle; vomerine teeth sep-

arated from intermaxillary plate, stout, rounded, eight to sixteen in number, in a double or an irregular and partially double row; mandibular teeth small, about eighteen on each side, with four pairs of much stouter granular teeth forming an inner row near symphysis.

Color dark brown or purplish brown, marbled everywhere with innumerable, fine, irregular, intricate whitish lines, or pale brown to whitish, everywhere marbled with irregular dark brown spots; chin and snout paler.

Here described from two specimens from Puerto Galera, Mindoro, each 160 millimeters in length, and a specimen from Dumaneguete, Oriental Negros, having a length of 174 millimeters; one previous Philippine record from southern Negros, by Jordan and Seale.

This beautiful little eel reaches a length of nearly 500 millimeters, and is known from the Riu Kiu to the Samoan Islands.

#### *Echidna amblyodon* Bleeker.

*Muraena amblyodon* BLEEKER, Act. Soc. Sci. Indo-neerl. 1 (1856) 72.

*Echidna amblyodon* BLEEKER, Atlas Ichth. Muraen. 4 (1864) 79, pl. 22, fig. 1; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 351.

Depth 11.4 in total length, head  $6\frac{1}{2}$ , and 2.5 in trunk; tail 0.9 the length of head and trunk together; eye 7.2 in head, 1.5 in snout, which is 4.8 in head; mouth ample, extending well behind eyes, 2.57 in head; gill openings smaller than eyes; dorsal beginning before gill openings, low anteriorly, but wide

on tail, as is also the anal; five rows of stout teeth on intermaxillary plate, inner rows largest; a double row on maxillaries, inner row much the larger; teeth on vomer not separated from those of intermaxillary plate, first three in a single row, then five pairs, then four in a single row, extending well beyond maxillary teeth; forward half of mandibles with a double row, the remainder with a single row of teeth.

Color in alcohol uniform brown, with paler throat and belly; small spots of darker brown scattered over the paler parts and faint indications of darker marblings elsewhere, especially posteriorly.

Here described from an unlabeled specimen found in the Bureau of Science collection, probably collected at Puerto Galera, Mindoro. The dimensions are as follows: Length, 114 millimeters; depth, 10; head, 18; trunk, 42; tail, 54.

An insignificant and rather uncommon little eel known from the eastern Sunda Islands, Celebes, the Moluccas, Samoa, and the Marquesas.

#### Genus EVENCHELYS Jordan and Evermann

*Evenchelys* JORDAN and EVERMANN, Proc. U. S. Nat. Mus. 25 (1903) 327.

*Thyrsoidea* BLEEKER, Atlas Ichth. Müræn. 4 (1864) 110; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 354.

Excessively elongated, slender, and more or less compressed eels, the tail from one and a half times to twice as long as head and trunk; anterior nostrils in simple tubes, without barbels or foliaceous appendages; posterior nostrils on top of head and above forward margin of eye; mouth closing almost completely and reaching far beyond eye, which is nearer tip of snout than corner of mouth; dorsal, anal, and caudal confluent, covered with skin; dorsal inserted in advance of the oblique gill slits which are low down on sides; no pectorals; teeth more or less compressed to needlelike, in two rows in upper jaw and forward part of mandible; one row of small teeth on vomer; intermaxillary plate with a marginal row of small teeth and four long depressible teeth in middle; lateral line conspicuous.

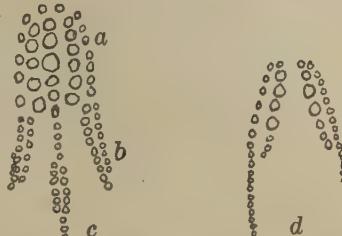


FIG. 11. *Echidna ambyodon* Bleeker, dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 4$ .

The single species known occurs throughout the Indo-Malayan region from Formosa to British India, Ceylon, Natal, and Queensland.

**Evenchelys macrurus (Bleeker).**

*Muræna macrurus* BLEEKER, Nat. Tijdschr. Ned. Ind. 7 (1854) 324.  
*Thyrsoidæa macrurus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 111,  
pl. 22, fig. 2; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3  
(1916) 355, fig. 174.

*Evenchelys macrurus* JORDAN and EVERMANN, Proc. U. S. Nat. Mus.  
25 (1903) 327.

Depth 31.5 to 47 in greatest length, head 10 to 14; head and trunk 1.5 to 2 in tail; eye 2.5 to 2.75 in snout, and 17 to 27 in head; mouth large, its gape from 2.4 to 3.4 in head; origin of dorsal from 0.2 to 0.3 the length of head before gill openings, which are oblique, almost horizontal slits with prominent margins; outer row of maxillary teeth very small to medium in size, the posterior ones smallest, twelve to twenty in each jaw; inner row of large needlelike depressible canines nine to twelve in number; intermaxillary plate with an outer row of eight to ten stout fixed teeth, with a central row of three long depressible fangs, the posterior one largest; a short row of small or medium-sized teeth on vomer, varying from three to nine each; each side of mandible with an outer row of sixteen to twenty pointed teeth varying greatly in size but all small, and an inner row of four to seven large depressible canines on each side of forward half; teeth varying much in size and number, apparently because of breakage and regeneration; lateral line conspicuous, the tubules far apart; height of dorsal at anus about 2.5 in body depth at same point.

Color of a fresh specimen, 1,464 millimeters long, uniform brown, becoming darker posteriorly, belly and throat paler to whitish; head ashy brown; dorsal concolorous except near tip of tail where it has a very dark margin, merging into blackish on caudal and contiguous part of anal; the latter fin very low with dark brown margin.

Another fresh specimen, 1 meter long, was uniform dark ashy brown, darker posteriorly, with top of head olive, yellowish around throat, and belly pale ashy; fins as in the previous specimen.

The color in alcohol varies from uniform grayish brown and yellowish to black, the posterior portion usually darkest, the belly and throat paler.

Body very elongate, very slender, and cylindrical or nearly so, being therefore exceedingly serpentine in form. Head low anteriorly, snout often thick, rounded at tip and tumid back to posterior nostrils so that there is a wide deep groove over eyes; mouth large and provided with a formidable array of teeth.

These eels lurk about the small opening to the pound, or innermost inclosure, of the fish corrals, or *baclad*, hiding in holes and seizing fish as they enter the corral. Fresh specimens are usually limp and often shrink very much in preservative. A fresh specimen with a length of 1,453 millimeters contracted 65 millimeters in 50 per cent alcohol and after being transferred to 70 per cent alcohol was found later to have lost over 100 millimeters.

This species breeds in the fall in the Philippines. A specimen taken from Manila Bay, September 1, 1921, having a length of 1,453 millimeters, was full of eggs, while another female with a length of 1,260 millimeters, caught in November, 1921, near Alaminos, Pangasinan Province, was ready to spawn.

I have examined two specimens from Lingayen Gulf, Alaminos, Pangasinan Province, three from Manila Bay, one from Iloilo, one from Agusan River, Mindanao, and one from Sandakan, Borneo, varying from 755 to 1,640 millimeters in length.

*Measurements of large specimens of Evenchelys macrurus.*

Length.	Head.	Trunk.	Tail.	Depth.
mm.	mm.	mm.	mm.	mm.
1,640	134	481	1,075	40
1,464	138	486	890	45
<sup>a</sup> 1,453	150	488	820	52
b 1,380	120	520	740	33
a 1,260	105	400	755	40
1,000	95	289	616	81

<sup>a</sup> Spawning female.

<sup>b</sup> An aberrant individual from Agusan River, the head and trunk being contained but 1.15 times in the tail. In spite of this it undoubtedly belongs here.

This eel is common in the Philippines, though it is not easy to get specimens, the fishermen usually cutting them up or at least removing the head before taking them to market. It is called *malabanos* in Tagalog, *ogdoc* by the Visayans of Iloilo, and *taguibos* in Cebu.

This fish reaches a length of more than 3 meters and some authors claim it is the largest of all eels, a statement with which I cannot agree, owing to its slenderness; nevertheless it may

easily be the longest. It frequents shallow seas and the mouths of rivers, sometimes ascending the latter, and is found from Natal to Formosa, the Pelew Islands, and Queensland.

Genus **PSEUDECHIDNA** Bleeker

*Pseudechidna* BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 272.  
*Strophidion* McCLELLAND, Calcutta Journ. Nat. Hist. 5 (1844) 187.

A genus of morays notable for the extreme length and slenderness of the compressed body, the origin of the dorsal strongly in advance of the gill opening, and the great number of fin rays, those in the dorsal being about 628, and in the anal about 335. In *Gymnothorax* and *Echidna* there are never more than from 250 to 400 rays in the dorsal and 150 to 280 in the anal. The height of the body is contained from 40 to 55 times in the total length, while the tail is less than twice the length of the head and trunk; the posterior nostrils have no tubes; the teeth are not serrated.

But one species is positively known.

**Pseudechidna brummeri** Bleeker.

*Muræna brummeri* BLEEKER, Nat. Tijdschr. Ned. Ind. 17 (1858-59) 137.

*Pseudechidna brummeri* BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 272.  
*Strophidion brummeri* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 109, pl. 18, fig. 1; JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 885.

*Strophidion polyodon* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 109, pl. 19, fig. 3.

*Muræna brummeri* GÜNTHER, Fische d. Südsee 3 (1910) 420; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 359, fig. 179.

*Gymnothorax megapterus* MAX WEBER, Siboga Exp., Fische (1913) 57, pl. 7, fig. 1.

Depth 40 to 55 in total length, head 12 to 17, and 4.6 to 7.25 in trunk; head and trunk together nearly as long as tail or more than a fourth shorter; head small, weak, lower jaw particularly so; eye covered with skin, 14 to 20 in length of head, 1.75 to 2.5 in snout and just forward of middle of cleft of mouth, which closes completely and is 3.7 to 4 in head; snout acutely rounded, 7 to 8 in head; posterior nostril above anterior margin of eye; dorsal fin begins from one-fourth to one-third the length of head before gill openings; anterior portion of dorsal equal in height to depth of body but posterior portion is 1.5 times the depth of tail; a row of five large pores on each side of jaws and a double row of four on top of snout.

Teeth small, the anterior ones larger; depressible, caninelike; maxillary teeth in one row, imperfectly two rowed, or in two rows on one or both sides; a single row of four to ten teeth on vomer; mandible with twelve to twenty-four teeth in a single row on each side; the forward ones are enlarged and may be irregularly two ranked. When the maxillaries have two rows of teeth the eel is the *polyodon* of Bleeker.

Color in alcohol uniform pale brown; head and especially jaws with numerous dark dots; each pore on head in a dark dot; fins paler, usually with a white margin.

I have two specimens, one from Puerto Galera, Mindoro, the other from Cagayan de Misamis, Mindanao.

*Measurements of Pseudechidna brumneri.*

	Puerto Galera.	Cagayan de Misamis.		Puerto Galera.	Cagayan de Misamis.
Length-----	mm. 410	mm. 525	Tail-----	mm. 222	mm. 298
Head-----	28	32	Depth-----	8.5	9.5
Trunk-----	160	200	Eye-----	2	2

A small, exceedingly slender eel with very elongate trunk, attaining a length of 800 millimeters. It occurs from Madagascar and Mauritius to the Riu Kiu Islands and southeast to the New Hebrides, Samoan, and Society Islands.

*Genus GYMNOTHORAX* Bloch

*Gymnothorax* BLOCH, Naturg. Ausl. Fische 9 (1795) 83; BLEEKER, Atlas Ichth. Muræn. 4 (1864) 82.

This genus includes those morays in which the posterior nostrils are round or oval openings on top of the head in front of or above the eyes and sometimes provided with a rim but never with a tube; the body is elongate but often thick and heavy, the depth being less than 30 in the length; the teeth are sharp, conical or compressed, not serrated, more or less pointing backward; the jaw teeth are in one or more series, with one or more rows of usually smaller teeth on the vomer; those on the intermaxillary plate are in one or two outer rows and there is a central row of from one to four depressible canines, the posterior ones often being very long and startlingly resembling the erectile fangs of poisonous snakes; Calmette states that they have a poison gland at their base and are truly venomous; sometimes the jaws have additional depressible canines but the total

number in the mouth is not more than ten; the lower jaw often has several pairs of large canines as an inner row near the symphysis. The inner row on the maxillaries disappears with age in most species, becoming a part of the outer row; the teeth are subject to great variation.

Head compressed, with characteristically elevated occipital region, due to the development of the powerful biting muscles; anterior nostrils tubular, on top of snout; eyes small and covered with skin; cleft of mouth reaching behind eyes, often not closing completely; origin of dorsal on head before or above gill openings, which are small slits more or less horizontal or circular.

These morays are common throughout the warmer parts of the Indo-Pacific and Atlantic Oceans and the Mediterranean Sea, often literally swarming in the shallow water about rocks and coral reefs, where some of the species attain a great size. Some of them are among the most beautifully colored of fishes, with rich and variegated hues and intricate, brilliant, often fantastic patterns. They are among the most active of eels, many of them greedy, bold fighters, striking like a snake at their prey.

Many of them are highly variable, so that a great number of nominal species have been described, based largely on color variations or the changes due to age, as large old specimens often diverge widely from the young not only in color but in dentition and proportions. Of the development of the young nothing is known. The sands and pools of the coral reef flats swarm with tiny murænids, mostly *Gymnothorax*, whose specific identity it is often impossible to determine. Like many other families of tropical fishes, it will be impossible to be certain of the morays until someone is able to study them *in situ* during their life cycle. Many very unlike species bear an extraordinarily close resemblance to each other, while individuals of the same species may have the most diverse appearance, even when of the same size.

*Key to the Philippine species of Gymnothorax.*

*a*<sup>1</sup>. One or two mesial teeth on intermaxillary, conical, and not longer than outside row.

*b*<sup>1</sup>. Maxillary teeth in one row or in two rows in the very young.

*G. pictus.*

*b*<sup>2</sup>. Maxillary teeth in two rows..... *G. thyrsoideus.*

*a*<sup>2</sup>. Mesial teeth on intermaxillary long slender depressible fangs, one to four in number.

*c*<sup>1</sup>. Maxillary teeth in two or three rows, the inner row of five or more.  
*d*<sup>1</sup>. Marginal teeth of intermaxillary in one row..... *G. tile*.  
*d*<sup>2</sup>. Marginal teeth of intermaxillary in two rows.  
*e*<sup>1</sup>. Color uniform brown..... *G. brunneus*.  
*e*<sup>2</sup>. Color not uniform brown but spotted or variegated.  
*f*. Head 1.7 to 2.9 in trunk; gape 2 to nearly 3 in head.  
*G. meleagris*.  
*f*. Head 4 to 5 in trunk; gape about 3.5 in head.... *G. polyuranodon*.  
*c*<sup>2</sup>. Maxillary teeth in one row, or with an inner series of one to four fangs which disappear with age.  
*g*<sup>1</sup>. Encircled by fifteen to thirty more or less irregular but definite dark crossbands.  
*h*<sup>1</sup>. Crossbands about thirty, about as broad as interspaces, these spotted with darker..... *G. punctatofasciatus*.  
*h*<sup>2</sup>. Seventeen to twenty-four crossbands, interrupted on belly and usually larger than interspaces..... *G. petelli*.  
*g*<sup>2</sup>. Body not banded with distinct crossbands.  
*i*<sup>1</sup>. Gill openings in a dark brown or black patch.... *G. flavimarginatus*.  
*i*<sup>2</sup>. Gill openings not in a dark patch.  
*j*<sup>1</sup>. Color uniform brown, dorsal moderately developed, not over half as high as body..... *G. boschi*.  
*j*<sup>2</sup>. Coloration not uniform but more or less spotted or variegated.  
*k*. Distinct dark spots over entire body, more or less in longitudinal rows.  
*l*. Spots smaller than interspaces, smallest or wanting on head.  
*G. undulatus*.  
*l*. Spots larger than interspaces, those on head not smaller.  
*G. favagineus*.  
*k*<sup>2</sup>. Body more or less marbled, reticulated, or with spots forming crossbands.  
*m*<sup>1</sup>. More or less distinct white spots on jaws.  
*n*<sup>1</sup>. A dark brown or black spot at angle of jaw with a white spot in front of it..... *G. chilosipilus*.  
*n*<sup>2</sup>. No dark brown spot at angle of jaw, but a large brown spot behind eye, bordered above and below by white lines or bands..... *G. zonipectus*.  
*m*<sup>2</sup>. No distinct white spots on jaws.  
*o*<sup>1</sup>. A black blotch at angle of mouth, uniting with a black band around chin..... *G. philippinus*.  
*o*<sup>2</sup>. No black blotch at angle of mouth.  
*p*<sup>1</sup>. Vomerine teeth in two series, except in large old specimens, when they are in one row. Yellowish, marbled and reticulated with dark brown or finely mottled with dark and yellowish..... *G. richardsoni*.  
*p*<sup>2</sup>. Vomerine teeth in a single row, or irregular and partially two rowed.  
*q*<sup>1</sup>. Color dark brown spotted with lichenlike whitish blotches; vomer with an irregular partially double row of teeth; anal fin with white margin.  
*G. kidako*.

*g<sup>2</sup>*. Not spotted with lichenlike blotches; no white margin on anal; teeth on vomer in one row; ground color dark with a network of white or yellowish lines.

*r<sup>1</sup>*. Tail much shorter than head and trunk; lines on body and tail very fine..... *G. pseudothyrsoideus*.

*r<sup>2</sup>*. Tail longer than or nearly equal to head and trunk together.

*s<sup>1</sup>*. Head 2 to 2.6 in trunk; tail longer than head and trunk ..... *G. undulatus*.

*s<sup>2</sup>*. Head 2.75 to 3 in trunk; tail a little longer or shorter than head and trunk..... *G. favagineus*.

*Gymnothorax pictus* (Ahl).

*Muræna picta* AHL, De Muraena et Ophichtho, Thunberg Dissert. 3 (1789) 6, pl. 2, fig. 2; GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 116; DAY, Fishes of India (1878-88) 672, pl. 172, fig. 4; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 362, figs. 175, 180, 182, 183.

*Gymnothorax pictus* BLOCH and SCHNEIDER, Syst. Ichth. (1801) 529; BLEEKER, Atlas Ichth. Muræn. 4 (1864) 87, pl. 26, figs. 3 and 4; pl. 28, fig. 3; pl. 29, fig. 1; pl. 45, fig. 3; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 103, pl. 19.

*Muræna lita* RICHARDSON, Voyage Erebus and Terror, Fishes (1844-1848) 84.

*Muræna polyophthalmus* BLEEKER, Act. Soc. Sci. Indo-neerl. 3 (1858) 15.

*Gymnothorax polyophthalmus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 96, pl. 30, fig. 3.

*Gymnothorax pictus*, *litus*, and *polyophthalmus* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 198, 199.

*Gymnothorax pictus* and *litus* JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 239.

Depth 14.4 to over 20 in total length; head 2.4 to 2.7 in trunk and 7 to 8 in length; head and trunk together the same length, or somewhat shorter than tail in my specimens; in one specimen which has had the tail bitten off and healed over, head and trunk are slightly longer than tail; eyes 8.3 to 9 or 10 in head and 1.4 to about 1.8 in the bluntly rounded snout which is 5.5 to over 6 in head; mouth closes completely, and is 2.4 to nearly 3 in head; origin of dorsal very slightly in advance of gill openings.

Teeth sharp, pointed, in one row in maxillaries; the very young have two rows, the inner gradually disappearing; a single row of ten to fourteen stouter teeth on intermaxillary plate, with a single central tooth which is not fanglike and is no larger than the others; in very young specimens there is an outer row of small teeth inclosing two or three central teeth; teeth on vomer in two

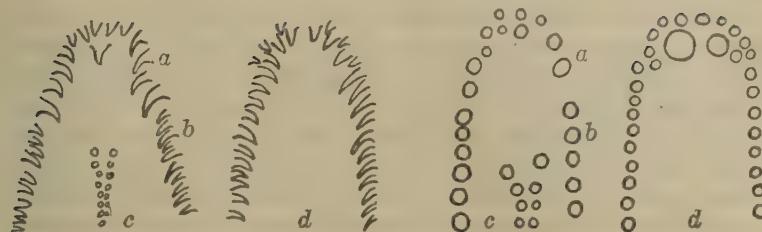


FIG. 12. *Gymnothorax pictus* (Ahl), dentition of two specimens, showing variation; *a*, intermaxillary; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 2$ .

short rows, the forward end more or less forked; the very young have but one short series; teeth in lower jaws in two rows in the young, the outer series of small teeth disappearing with age and remaining more or less evident around tip of jaw.

Color in alcohol handsome brownish gray, flecked and speckled with innumerable small to minute black spots, which are few or absent beneath, and on anal fin; even the eyes are spotted; in the very young the ground color is yellow, with three irregular lengthwise rows of circular blackish spots about the size of eye, which soon have a yellow center; as the fish grows the spots become irregular and the yellow center increases in size till they are broken up and the adult pattern finally develops; but in many specimens traces of the first color pattern are evident, the spots being confluent and forming more or less ring-shaped figures.

I have examined several specimens from Calapan, Mindoro, and the species has been recorded from Samar by Peters, from southern Negros by Jordan and Seale, and from Ticao, Cuyo, and Cagayancillo Islands by Jordan and Richardson.

This handsome and distinct eel reaches a length of nearly 800 millimeters and occurs on reefs and along seacoasts from the east coast of Africa, Natal, and Madagascar to Australia, the islands of the south Pacific, Hawaii, and the Riu Kiu Islands.

#### *Gymnothorax thyrsoideus* (Richardson).

*Muraena thyrsoidea* RICHARDSON, Voyage Sulphur, Ichth. (1844) 111; Voyage Erebus and Terror, Fishes (1844-48) 91; GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 113; DAY, Fishes of India (1878-88) 672, pl. 142, fig. 3; WEEER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 365.

*Gymnothorax prosopaeion* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 88, pl. 39, fig. 3.

*Gymnothorax thyrsoideus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 103 (description after Cantor); JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 198.

Depth 14.7 to 20.5 in length, head 8.58 to 8.9, and 2.5 to 2.7 in trunk; head and trunk together 1.39 to 1.45 in tail. ("Height 17-21; head 9 to more than 10, thrice in trunk. Head and body somewhat shorter than tail."—Weber and Beaufort.) Eye circular and rather small, 9.2 to 12.5 in head and 1.4 to 2 in the short, blunt, rounded snout; lower jaw curved so that the horizontal mouth does not close completely; gape reaches far behind eyes and is 2.72 to 3 in head; dorsal begins on occiput 0.4 to 0.5 the length of head in advance of gill opening; vertical fins low, dorsal less than one-half the height of body; gill opening with a dark mark; maxillary with twelve to fourteen rather small compressed teeth in outer row and from eight to ten longer, pointed, depressible teeth in inner row which is curved and separated by a broad interspace from the outer teeth; intermaxillary plate with ten to fourteen teeth in outer row, all large, stout, fixed, with recurved points, except those at tip of jaw, which are small; one or two central teeth scarcely larger than the others and hardly depressible; vomer with a double row of low, broad, rounded teeth, diverging anteriorly, the anterior tooth in each row the largest; six or seven pairs of teeth on vomer, sometimes with a long irregular row extending posteriorly, seven or eight in number; lower jaw with about twenty-five teeth on each side, those of anterior half largest, and an inner row of three to six larger teeth on each side at forward end.

Color uniform light yellowish, thickly dotted and spotted with purplish brown, leaving the ground color as pale spots; anterior half of head uniform dark purplish brown without markings; the spots and dots may coalesce and form marblings, especially on tail; belly not paler; fins colored like body.

Color in alcohol, similar but much duller.

Head, trunk, and tail much compressed, head deep. Width of head less than one-third its length. Here described from

*Measurements of Gymnothorax thyrsoideus.*

	Sitanki.	Leyte.	Guimaras.
Length	mm.	mm.	mm.
Depth	515	410	430
Head	85	20	24
Trunk	60	46	50
Tail	155	124	125
Eye	300	240	255
Gape	5	5	4
	22	16	17

three specimens, one of which I obtained at Sitanki, one caught at Cabalian, Leyte, by Mr. Lopez, and one at Jordan, Guimaras, by Mr. Montalban.

This species is easily recognized by the dentition. While my specimens have a black mark around the gill openings the only author who seems to have noticed this character is Day who says "gill opening sometimes with a black mark around it." Jordan states that a living Samoan specimen had a pale edge to the dorsal, but the fins do not ordinarily have a pale margin.

This species reaches a length of 650 millimeters and has a wide range, occurring from the Seychelles and the coast of Arabia to China, Guam, West Australia, the Samoas, Navigator, and Tonga Islands.

*Gymnothorax tile* (Hamilton Buchanan).

*Murænophis tile* HAMILTON BUCHANAN, Fishes Ganges (1822) 18, 363.

*Muræna vermiculata* RICHARDSON, Voyage Erebus and Terror, Fishes (1844-48) 92.

*Muræna gracilis* RICHARDSON, Voyage Erebus and Terror, Fishes (1844-48) 92.

*Gymnothorax tile* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 97, pl. 34, fig. 1.

*Echidna tile* PETERS, Monatsber. Akad. Wiss. Berlin (1868) 275.

*Muræna tile* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 112; DAY, Fishes of India (1878-88) 668, pl. 170, fig. 4; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 370.

Depth 16 to 23 in total length, head 7.4 to nearly 8, and a little less than 3 to 3.3 in trunk; head and trunk together equal or slightly exceed length of tail; eye 12 to 14 in head, 1.5 to 2 in the prominent snout and nearer angle of mouth; gape, measured from the mandibular symphysis, 3.8 to 4.2 in head; origin of dorsal slightly before gill openings, which are about the size of eyes; the conical teeth are in two rows in maxillaries, an outer row of fourteen or more, enlarged posteriorly, and an inner row of five to eight larger teeth; a single row of twelve to fourteen large teeth on intermaxillary plate, sometimes with a few small ones intermingled, and a middle row of three still larger canines; twenty or more blunt conical teeth on vomer, in two rows or irregularly biserial; lower jaws with about twenty-four teeth on each side, in two rows at anterior portion.

Color in alcohol brown or brownish black, with very many irregular minute light specks of unequal size which disappear more or less in old specimens on anterior half of body, but which are distinct on dorsal fin and tail.

This species was collected by Jagor on a coral reef near Láuang, on the north coast of Samar, but has not been obtained since then in the Philippines though it undoubtedly is widely distributed in the Archipelago. It is abundant in the seas and river mouths of India, being common in the Hooghly at Calcutta, and is found in the Indian Ocean from Ile de Bourbon north-eastward and in the East Indies to Borneo and Ceram. It attains a length of over 600 millimeters.

*Gymnothorax brunneus* sp. nov.

Depth 17.7 in length, 6% in trunk and 2 $\frac{1}{2}$  in head which is 8.42 in length and 2.94 in trunk; head and trunk together about half the length of head shorter than tail; eyes same size as gill openings and 9.5 in head and twice in snout, which is bluntly rounded and goes 4.75 in head; mouth 2 $\frac{3}{8}$  in head; posterior

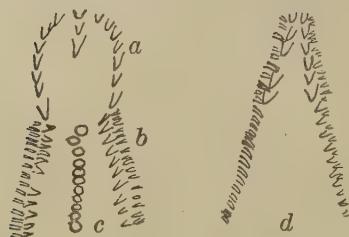


FIG. 18. *Gymnothorax brunneus* sp. nov., dentition; a, intermaxillary; b, maxillaries; c, vomer; d, mandibles.  $\times 4$ .

nostrils above and just a little forward of center of eyes; jaw teeth all small and sharp pointed; maxillaries with an outer row of sixteen minute, compressed teeth and an inner row of ten pointed, depressible teeth more than twice as large; intermaxillary plate with fifteen much stouter teeth and two mesial depressible teeth but little

larger, all with recurved points; vomer with ten blunt, rounded teeth in a single row; lower jaw with about twenty-five small teeth on each side, more or less irregular, and six pairs of larger depressible teeth forming a double inner row near symphysis, all with their points directed backward.

Color uniform brown, snout paler, and chin pale tan; fins paler brown than body.

Body compressed; dorsal beginning not more than the diameter of an eye in advance of the gill opening; dorsal moderate. Its height at anus one-third the depth of body; anal low.

Here described from a specimen in the Bureau of Science collection, probably from Puerto Galera, Mindoro. Its dimensions are as follows: Length, 160 millimeters; head, 19; trunk, 56; tail, 85; depth, 9.

This eel is separated from similarly colored species of *Gymnothorax* by the dentition. The outer maxillary row of minute

teeth is difficult to make out, the inner row being apparently continuous with those of the intermaxillary plate. This may be the young of *G. monochrous*, but Bleeker's description fails to show its identity, and I cannot place it under the *Muræna boschi* of Weber and Beaufort.

*Gymnothorax meleagris* (Shaw).

*Muræna meleagris* SHAW, Nat. Misc. (1809) pl. 220; RICHARDSON, Voyage Erebus and Terror, Fishes (1844-48) 93; GÜNTHER, Fische d. Südsee 3 (1910) 410; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 367.

*Gymnothorax duivenbodei* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 89, pl. 25, fig. 1.

*Gymnothorax buroensis* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 90, pl. 46, fig. 1.

*Gymnothorax meleagris* JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 94.

*Gymnothorax meleagris* and *buroensis* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 197, 199.

Greatest depth 1.56 in head, 3.2 in trunk, which is about twice (2.05) as long as head; interorbital space one-sixth the length of head, which is three times as long as its greatest breadth; the large round eye 1.5 in the narrow, rather blunt snout, and 7.8 in head; origin of dorsal eleven-thirteenths the length of head from tip of snout; gill openings smaller than eye; cleft of mouth horizontal, closing completely, reaching more than an eye diameter beyond eye,  $2\frac{1}{2}$  in head; teeth of upper jaw in two series, the outer one of fifteen or twenty small, depressible, compressed sharp teeth which are directed backwards; inner row has six or eight long, sharp, depressible canines; there are indications of a third row of canines on one side; outer row of teeth continued on intermaxillary plate, those at tip of jaw smallest; a group of depressible canines in the middle line, the second and third of the median series the longest teeth of mouth; each mandible with about twenty-five or thirty small, sharp, compressed, subequal teeth, their points directed backward; a group of larger canines near tip of lower jaw; all teeth depressible; teeth on vomer small, pointed, a single series of six anteriorly, merging into an irregular double row of about nine more posteriorly.

Color in alcohol purplish brown apparently overlying a gray ground color, with spots of dark or blackish brown becoming fused and definitely arranged in crossbands toward and upon tail, the lighter color showing as irregular whitish flecks or spots

between, especially on underside of tail; upper jaws and cranium almost uniform purplish brown; belly and throat pale, densely speckled with small dark flecks.

Here described from a mutilated female about to spawn, collected at Cabalian, Leyte, May 19, 1921. The tail has been bitten off and healed, and a flap of skin with the characteristic white tip of the caudal has grown out to form a pseudo fin. While the specimen does not agree with any of the published figures, its proportions and dentition place it here and it is undoubtedly a variety of *Gymnothorax meleagris*, probably closest to Günther's variety "f."<sup>10</sup> Its dimensions are: Head, 39 millimeters; trunk, 80; tail, 112; gape, 18; eye, 5; snout, 7.5.

This species reaches a meter in length and ranges from the east coast of Africa to the East Indies, Hawaii, Australia, and the South Sea Islands. Günther and Weber and Beaufort have united many species under this name; most of them unquestionably belong here.

*Gymnothorax polyuranodon* Bleeker.

*Muræna polyuranodon* BLEEKER, Nat. Tijdschr. Ned. Ind. 5 (1853) 248.

*Gymnothorax polyuranodon* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 89, pl. 30, fig. 2.

*Muræna polyuranodon* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 114; Fische d. Südsee 3 (1910) 421; BOULENGER, Ann. & Mag. Nat. Hist. VI 15 (1895) 187; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 369, fig. 185.

Height 19 to 28; head 9 to more than 11, 4 to 5 times in trunk. Tail somewhat shorter than head and trunk. Eye 10-12, more than 1.5 in snout, situated above middle of cleft of mouth, which goes more or less than 3½ times in length of head, is horizontal and closes completely. Origin of dorsal slightly before gill openings, which are a little wider than the eye. Teeth conical, with the sharp point directed backwards, in the maxillaries in 2 or 3 series, on the intermaxillary plate in 2 peripheral series, the teeth of the inner series stouter, in the centre 1 or 2 compressed, recurved, moveable teeth; on vomer a single series of 5 to 10 teeth. Mandibular teeth posteriorly uni- to triserial, anteriorly stouter and bi- to quadriserial. Yellowish brown, with irregular rounded, more or less confluent black spots. On the head the spots coalesce into more or less complete longitudinal bands, separated by light longitudinal streaks. Length 700 mm.—Weber and Beaufort.

A specimen only 275 millimeters long was collected by E. H. Taylor in Saub River, Cotabato, Mindanao, April 29, 1923. Boulenger records the species from Palawan.

<sup>10</sup> Fische d. Südsee 3 (1910) 411.

This eel occurs along the coasts and ascends rivers throughout the East Indies and southeast to the Fiji Islands.

**Gymnothorax punctatofasciatus Bleeker.**

*Muraena catenata* BLEEKER, Act. Soc. Sci. Indo-neerl. 1 (1856) 66 (not Richardson).

*Gymnothorax punctatofasciatus* BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 167; Atlas Ichth. Muræn. 4 (1864) 99, pl. 31, fig. 4.

*Muraena punctatofasciata* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 106; DAY, Fishes of India (1878-88) 669, pl. 169, fig. 4.

Depth 22.5 to 27.7 in total length, head 8.1 to 8.3, and 2.7 in trunk; tail a little longer than head and trunk together; head and trunk contained about 1.2 in tail; eyes halfway between tip of snout and angle of mouth, 9 $\frac{2}{3}$  to 10.8 in head, and twice in the narrow but rather bluntly rounded snout; mouth large, its gape 2.8 to 3.4 in head; dorsal low, its origin before gill openings, which are a fifth larger than eyes; maxillaries each with about sixteen small, sharp-pointed teeth and two inner canines in a row near forward end; about twelve teeth around margin of intermaxillary teeth and three needlelike canines forming a central row; eight small teeth in a single row on vomer; about twenty teeth on each side of lower jaw, and two or three much larger ones on each side near symphysis, some of which may be in an inner row.

Color in alcohol brown or yellowish or grayish brown, with twenty-eight to thirty-five (thirty and thirty-one in our specimens) dark brown, more or less irregular rings, some of which may be incomplete or divided, but most of which are complete. The interspaces are about as wide as the rings and like the head are closely dotted and spotted with darker brown.

Here described from a specimen 225 millimeters long, collected at Cagayan de Misamis, Mindanao, and from another, 236 millimeters long, probably from Cebu but possibly from Taytay, Palawan. Previously recorded from the Philippines by Jordan and Seale from Negros Island. This small and easily recognized moray ranges from Zanzibar to the Philippines.

Since the above was written I have seen a specimen in the collection of the University of the Philippines, with thirty-four rings. Another specimen, 455 millimeters long, with twenty-eight rings, was collected by G. A. Lopez of the Bureau of Science, at Cebu, Cebu.

**Gymnothorax petelli Bleeker.**

*Muraena petelli* BLEEKER, Nat. Tijdschr. Ned. Ind. 11 (1856) 84; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 372.

*Gymnothorax petelli* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 99, pl. 32, fig. 1; JORDAN and SEALE, Bull. U. S. Fish Comm. 25 (1905) (1906) 197; JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 240.

*Gymnothorax leucacme* JENKINS, Bull. U. S. Bur. Fisheries 21 (1902) 427, fig. 2.

*Gymnothorax waialuae* SNYDER, Bull. U. S. Fish Comm. 22 (1902) 520, pl. 6.

Height 18 to 20, head 8-9½, 2½-3 times in trunk. Tail longer than head and trunk. Eye 9 to 10, situated somewhat nearer to the end of the snout than to the corner of the mouth. Snout rather pointed, not twice as long as eye. Cleft of mouth about 2½ times in head. Mouth not shutting completely in old specimens. Dorsal rather low, beginning before gill openings, which are about as wide as eyes. Maxillaries with a series of 12-14 conical, somewhat compressed teeth, anteriorly with an inner series of 3 long depressible teeth, which disappear with age. On intermaxillary plate a peripheral series of about 12 rather long depressible teeth, mesially with 2 or 3 larger fang-like ones. Vomer with a single series of 3 conical teeth. Mandibles with 18-25 teeth on each side in a single series. Brown, with 17-24 dark cross bands, which are generally larger than the interspaces between them. They are interrupted on the belly. The first band on the snout, the third through origin of dorsal. In old examples most of the bands are broken into spots, but the anterior dorsal bands remain distinct. Length 1,100 mm.—Weber and Beaufort.

This eel is known from the Philippines from a very young specimen collected at Calayan Island north of Luzon and described by Jordan and Richardson. It undoubtedly occurs throughout the Philippines but has been overlooked by collectors. This handsome moray occurs from Mauritius and the Red Sea to the Hawaiian Islands and the Samoas.

#### *Gymnothorax flavimarginatus* (Rüppell).

*Muraena flavimarginata* RÜPPELL, Atlas Reise Nördl. Afrika, Fische des Rothen Meeres (1828) 119, pl. 30, fig. 3; GÜNTHER, Fische d. Südsee 3 (1910) 417; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 374.

*Gymnothorax formosus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 94, pl. 30, fig. 1.

*Gymnothorax javanicus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 95, pl. 35, fig. 2.

*Gymnothorax flavimarginatus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 95, pl. 32, fig. 2; pl. 34, fig. 3; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 99, pl. 17.

*Gymnothorax flavomarginatus* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 200; JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 240.

Depth 9.74 to 22 in length, head 6.95 to 9 in length, and from 2.75 to 3.5 in trunk; head and trunk together as long as or a

little shorter than tail; eyes of small to medium size, a little forward of middle of gape, 9 to 17.3 in head and 1.9 to 2.6 in the rather short, oblong, bluntly rounded snout; mouth large, its cleft from a little more than twice to 2.5 in head; the lower jaw becomes much curved in large old specimens so that the mouth cannot be closed completely; dorsal of moderate height, less than half the depth of body, its origin slightly in advance of gill openings, which are much larger than eyes; posterior nostrils somewhat tubulate, slightly anterior to or hardly above front margin of eyes; maxillary teeth slender, compressed, sharp pointed, larger anteriorly, ten or twelve on each side; young examples are said to have an inner anterior row of three long and slender teeth; intermaxillary plate has an outer row of eight to ten large sharp teeth with two mesial depressible canines, the posterior one being very long; nineteen or twenty teeth on each side of lower jaw, the second and third from symphysis being very large canines; all jaw teeth strongly directed backwards; vomer has about six pairs of teeth arranged in a broadly diverging fork, followed by a few teeth forming a single posterior row; vomerine teeth small and sharp pointed; the teeth forming one side of the Y are often missing, as is the case in my smallest specimen.

Fresh specimens are everywhere of a rich purplish brown, which becomes paler and more or less yellowish in alcohol; the back and sides are densely mottled and spotted with very dark purplish brown to blackish, the spots larger and more irregular posteriorly; the fins colored and blotched like the body, but darker; the spots on the head are very small and are absent on the jaws and snout, the last very dark in color; the inside of the mouth is also dark purplish brown.

Color in alcohol ranges from yellowish to dark brown, and dark purplish brown, everywhere mottled or spotted and blotched with deep brown or blackish; these spots may fuse to form larger irregular patches; fins concolorous but darker, dorsal dusky or blackish; dorsal and anal usually with a pale yellowish or whitish margin, this sometimes visible only posteriorly and on caudal or entirely absent; a dark spot usually at corner of mouth; gill openings always in a large black or dark brown blotch; the spots on head small to very small; jaws and snout unspotted and usually very dark.

A very robust female specimen, containing eggs, nearly ready to spawn, was caught April 23, 1922, at Monja Island, which lies at the entrance to Manila Bay. Its dimensions are as

follows: Length, 1,225 millimeters; depth, 120; head, 175; trunk, 420; tail, 630; gape, 85.

A huge specimen captured December 21, 1922, on Subunguin Reef, near the town of Bondoc, Tayabas, had the following dimensions; Length, 1,510 millimeters; depth, 155; head, 217; tail, 692; mouth, 105; snout, 33; eye, 12.5. The tail is shorter than the head and trunk by over 18 per cent of its own length, but it has probably had the tip bitten off, as it is wide and notched at the end instead of tapering to a point. The projecting lower jaw is very much curved so that the cavernous mouth cannot be closed. Such individuals as this, with their enormous head and jaws and thick, bulky body, enable one to realize their strength and biting power and to understand why they are held in such dread by the fishermen.

The Bureau of Science collection also contains a specimen 680 millimeters long from Zamboanga, Mindanao, and a typical head, 133 millimeters in length, from Balabac Island.

This eel looks something like *Gymnothorax thyrsoideus*, but its body is more robust and less strongly compressed, the dark patch at the gill opening is larger and more evident, the color of the head is different, and the dentition is entirely unlike.

A large species, reaching a length of 1,600 millimeters, and of wide distribution, occurring throughout the warm parts of the Indian and Pacific Oceans, north to Formosa and Hawaii, south to Madagascar and the Austral Islands.

#### *Gymnothorax boschi* Bleeker.

*Muræna boschi* BLEEKER, Verh. Bat. Gen. 25 (1853) Muræna 52;

WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 386.

*Gymnothorax boschi* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 105, pl. 46, fig. 3.

*Gymnothorax monochrous* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 106, pl. 47, fig. 2.

*Muræna afra* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 123; pro parte.

Depth 11 in total length and 1.78 in head, which is 2.6 in trunk and about 7 in total length; head and trunk together exceed tail by a third of head, tail a little less than 91 per cent of them or about 47.54 per cent of total length; eye moderately large, about 10 in head and  $1\frac{1}{3}$  in the broad, rather blunt snout which is a little more than 5.5 in head; mouth large, 2.25 in head; interorbital space about three-fourths snout; greatest width of head about 3.75 in its length; posterior nostril over anterior margin of eye; origin of dorsal in advance of gill openings about 0.3

the length of head; gill openings about two-thirds the diameter of eye; teeth long, pointed, coarse, but very irregular in size, directed backwards, the posterior ones much the smallest; about ten on each maxilla and a row of twelve much larger ones on intermaxillary, with three depressible canines on central line; one small sharp tooth far back on vomer; about twenty teeth of very uneven size but mostly large and sharp pointed on each mandible, with two large depressible canines forming an inner series near symphysis.

A stout, heavy-bodied eel, with the dorsal well developed, but less than half as high as body; anal very low.

Color in alcohol uniform umber or blackish brown, belly paler. Here described from a large eviscerated specimen having a length of 610 millimeters, Bureau of Science collection No. 4432, from Zamboanga. It is nearest to Bleeker's *Gymnothorax monochrous* which Weber and Beaufort have united with his *G. boschi*. I have seen what is undoubtedly this species in the fish markets in Manila and southward, but the specimens have always been cut up so that I have been unable to secure them for study.

There is a living *Gymnothorax* in the Bureau of Science aquarium which does not agree with any described species, but I place it here rather than describe it as new. It has a thick heavy body, 640 millimeters long, in which the depth is  $10\frac{1}{3}$  times; head 1.5 times as long as depth and 7.1 in total length and 2.55 in trunk; tail equal to head and trunk together; eyes very full and rounded, with brown iris, and contained 10 times in head and twice in the long narrow snout; width of interorbital space equals  $\frac{7}{9}$  the length of snout; jaws curved and do not close completely, gape 2.3 in head; origin of dorsal one-third the length of head in advance of gill openings, which are about seven-ninths as large as eyes; dorsal well developed, its height along middle of trunk 2.5 in body depth and its height over anus half the depth at that point; anal fin thick and rather low.

It is of course not possible to count the teeth, but they are in a single row throughout, with three mesial canines on the intermaxillary plate, the posterior one being very long and needlelike.

Color uniform liver brown, somewhat darker dorsally and on dorsal fin; head much paler, being uniform pale clay or pale yellowish brown; belly similar, much paler than rest of trunk and tail. There is a narrow and rather inconspicuous very pale yellowish margin to dorsal fin; no marks, blotches, or mottling anywhere.

This specimen was collected at either Puerto Galera or Calapan, Mindoro.

This eel has the dorsal margin characteristic of *Gymnothorax hepaticus* or *albimarginatus*, and of some specimens of *Gymnothorax flavigularis*, but lacks the very high dorsal characteristic of the first two while the relative proportions of depth and length are very different.

It is probable that the *Muræna hepatica* of Weber and Beaufort and their *Muræna boschi* overlap and include five nominal species, and that a full series of living material would result in the recognition of three distinct species.

*Gymnothorax undulatus* (Lacépède). Plate 9, fig. 1.

*Murænophis undulata* LACÉPÈDE, Hist. Nat. Poissons 5 (1803) 629, 644.

*Muræna fimbriata* BENNETT, Proc. Comm. Zool. Soc. 1 (1831) 168.

*Muræna bullata* RICHARDSON, Zool. Voyage Erebus and Terror, Fishes (1844-48) 86.

*Muræna cancellata* RICHARDSON, Zool. Voyage Erebus and Terror, Fishes (1844-48) 87, pl. 46, figs. 1-5.

*Gymnothorax isingraenoides* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 91, pl. 35, fig. 1; pl. 36, fig. 1.

*Gymnothorax bullatus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 91, pl. 27, fig. 2; pl. 43, fig. 3.

*Gymnothorax cancellatus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 93, pl. 32, fig. 3; pl. 33, fig. 2; pl. 39, fig. 1.

*Gymnothorax agassizi* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 95, pl. 41, fig. 2.

*Muræna fimbriata* DAY, Fishes of India (1878-88) 670, pl. 172, fig. 1.

*Gymnothorax undulatus* JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 (1903) (1905) 98, pl. 16.

*Muræna undulata* GÜNTHER, Fische d. Südsee 3 (1910) 413, pl. 164, 165; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 376, fig. 186.

Depth 8.25 to 19.5 in length over all; head 2 to 2.6 in trunk and 6.5 to nearly 8 in total length; tail varies from slightly more to half a head length more than length of head and trunk together; eye moderately large, 8.4 to 8.75 in head and 1.5 to 1.75 in snout, which is usually rather long and narrow, with rounded tip and 4 to 5.6 in head; mouth large, usually closing completely, 2 to 2.24 in head; origin of dorsal 0.22 to 0.19 the length of head before gill opening, which is as large or three-fourths as large as eye; interorbital space varies from diameter of eye to length of snout; greatest width of head from 2.25 to 4.25 in its length; vertical fins well developed, dorsal less than half the depth of body, anal much lower; maxillary teeth in a single row of about

fifteen (twelve to twenty) small, compressed, backward-pointed teeth in each jaw; in younger specimens an inner row of one to three longer, erect, fanglike depressible teeth; outer row continuous on intermaxillary plate with a row of much larger caninelike teeth, ten to sixteen in number; a row of three long needlelike depressible fangs on center of maxillary plate, the posterior one longest; from sixteen to twenty small, compressed, backward-pointed teeth on each side of lower jaw, and from four to eight large immovable canines around symphysis; a single row of five to eight small teeth on vomer.

Color of a living specimen in the Bureau of Science aquarium, collected at Calapan, Mindoro, light olive gray, everywhere specked with exceedingly numerous and minute dark dots, throat and belly paler than other parts; about three longitudinal rows of large circular or irregular spots, mostly not larger than eyes; dorsal fin with bandlike spots which may connect with upper row on body; spots on head few and much smaller.

An alcoholic specimen differs from the above only in having the gray slightly suffused with a reddish brown, especially about the head and snout. A specimen from Puerto Galera, Mindoro, and one from Samal Island in the Gulf of Davao are typical of the variety *fimbriata*, having a ground color of reddish brown, with smaller and fewer spots; otherwise they are like the living specimen described. In all the above the dorsal and the anal have a more or less evident white border.

A specimen from Dumaguete is the *Gymnothorax agassizi* of Bleeker.

In a large specimen of unknown locality, 660 millimeters long, the ground color is yellowish gray, thickly overspread with dark spots and markings so that it is reduced to more or less of an indeterminate network of whitish or yellowish lines and narrow irregular spaces, the animal therefore marbled with light and dark; posteriorly the dark spots are more definite, larger, in longitudinal rows, and coalesce to form vague transverse bands. This specimen is remarkable for the extreme depth of the head, as shown in the figure. I have also examined three small specimens in the collection of the Ateneo de Manila, obtained at Tandag, Surigao.

A large and powerful, fiercely biting moray, said to reach a length of 2 meters. It is an exceedingly variable and widespread species, previously recorded from Manila by Kner, and from Zamboanga by Seale and Bean under the name of *G. fimbriatus*. It occurs from Madagascar, Mauritius, the east coast of Africa,

and the Red Sea to the Riu Kiu Islands, Hawaii, Australia, and everywhere among the South Sea Islands; abundant throughout its range.

*Gymnothorax favagineus* Bloch and Schneider. Plate 11, fig. 2.

*Gymnothorax favagineus* BLOCH and SCHNEIDER, Syst. Ichth. (1801) 525.

*Gymnothorax isingteena* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 92, pl. 37, fig. 1.

*Gymnothorax tessellatus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 93, pl. 27, fig. 3; pl. 28, fig. 1.

*Muræna tessellata* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 106.

*Gymnothorax favagineus* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 199.

*Muræna favaginea* WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 378, fig. 187.

Depth 15.5 to 21.5 in total length; head 7.5 to 9 in length and 2.75 to 3 in trunk; tail a little longer or a little shorter than head and trunk together; eye 10 to 12 in head and twice in snout; the wide mouth  $2\frac{1}{3}$  to 2.5 in head; length of anterior nostril tube about twice in eye; origin of dorsal 0.657 the length of head from snout; height of dorsal over middle of trunk nearly equal to half depth of body; anal much less developed than dorsal; maxillary teeth in one row, rather small and uniform in size, compressed, pointed, directed backwards, about fifteen in each jaw, the first one larger and caniniform; a single series of canines forms a row around margin of maxillary plate, with three much larger depressible canines forming a central row; these separated by a gap and then a row of very small teeth down vomer, about eight in number; fifteen or more teeth on each side of mandible, first pair small, followed by three pairs of large ones, the remaining teeth medium sized, all pointed and directed backward.

A very well defined species of handsome and distinct coloration, separating into well-marked varieties; in the variety *isingteena* the whole animal is covered with large rounded or polygonal black spots which are separated by distinct interspaces of the pale whitish or yellowish olive ground color, the spots mostly wider than interspaces; the variety *favagineus* has the spots separated by narrow lines, the ground color being reduced to a broad network around the spots.

I have examined one alcoholic specimen from Manila, belonging to the variety *isingteena*, with dimensions as follows: Length, 540 millimeters; head, 70; trunk, 195; tail, 575. There is also

a stuffed Philippine specimen in the museum of the Ateneo de Manila.

This eel attains a length of considerably over a meter, and occurs from the east coast of Africa and Mauritius Island to the south coast of Arabia, throughout the East Indies, and on to the New Hebrides and the Paumotus.

*Gymnothorax chilosphilus* Bleeker. Plate 11, fig. 1.

*Gymnothorax chilosphilus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 103, pl. 45, fig. 2.

*Gymnothorax sagenodeta* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 100, pl. 40, fig. 4 (not of Richardson).

*Gymnothorax samalensis* SEALE, Philip. Journ. Sci. § A 4 (1909) 492.

*Muræna chilosphilus* GÜNTHER, Fische d. Südsee 3 (1910) 415; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 379, fig. 188.

Depth 15 to more than 19 in length in my specimens, head 7 to 7.7 (8.5, Weber and Beaufort) and 2 to 2.66 in trunk; tail a little longer than head and trunk together, exceeding them by a tenth or more, occasionally by a distance equal to 0.73 of head; eyes moderately large, circular, 8.6 to 9.6 in head, located about over middle of mouth, 1.4 to 1.6 times in the rather oblong, bluntly pointed snout; gape 2.3 to 2.8 in head; fins moderately developed, anal low, dorsal less than half the body depth, origin of dorsal slightly (rarely 0.4 the length of head) in advance of gill openings, which are much narrower than width of eyes; posterior nostrils small, not at all tubulate, over anterior portion of pupil; maxillary teeth small to very small, compressed, backward pointing, eight to fourteen in number; sometimes there is an inner row of two to five much longer, depressible, fanglike teeth; intermaxillary plate has an outer row of twelve to fourteen teeth, largest posteriorly, the most anterior ones usually much smaller; one specimen with very small teeth alternating with the fourteen large ones; three or four mesial depressible fangs, first one very small, third and fourth usually very long; vomer with nine to twelve small teeth in a single row, anterior ones largest; ten to twenty sharp, backward-pointed teeth, with a short inner row of two or three much stouter ones near tip, on each side of lower jaw.

Color in alcohol brownish to brown, with wavy, anastomosing, more or less complete dark brown crossbands, more evident on tail and dorsal and anal fins, sometimes practically wanting, especially anteriorly; belly and throat paler, yellowish to grayish; head brown, with a dark brown spot more or less evident at

angle of mouth; pores on jaws in white spots, with a large white spot before angle of mouth on lower jaw; sometimes a white streak on upper jaw just in front of angle of mouth.

I have examined four specimens in the Bureau of Science collection, one of them being the type of *Gymnothorax samoensis*, collected at Samal Island, in the Gulf of Davao, Mindanao; the others are without labels. They vary in length from 169 to 232 millimeters. One of them, a female ready to spawn, has almost no trace of crossbars and is almost uniform brown, with very pale belly and throat. Another specimen has the markings exceedingly well developed, strongly contrasting with the specimen just mentioned, and bears a remarkable resemblance in color to *G. richardsoni*.

This species may be distinguished in any color phase by its characteristic jaw markings and its dentition.

This is a small species, reaching a length of not more than a third of a meter, and has a narrow, compressed body and tail. It occurs throughout the East Indies to the Philippines on the north and southeast to the Samoas and Tahiti.

Since I wrote the above Mr. G. A. Lopez obtained a specimen in December, 1922, at the barrio of Anajawan, on the southern coast of Leyte. This specimen, which has a length of 268 millimeters, is a female with nearly mature eggs; in coloration it is very close to Bleeker's figure of *G. sagenodeta*.

#### *Gymnothorax zonipectis* Seale. Plate 11, fig. 3.

*Gymnothorax zonipectis* SEALE, Occ. Papers Bishop Mus. 4 (1906) 7, fig. 1.

*Gymnothorax indong* SEALE, Philip. Journ. Sci. § A 4 (1909) 491.

*Muraena zonipectis* GÜNTHER, Fische d. Südsee 3 (1910) 415, with text figure; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 381, fig. 181.

Depth 19.25 in total length and 2.5 in head, which goes 7.7 times in entire length and 2.48 in trunk; tail longer than head and trunk together by almost three-fourths the length of head; eyes twice in snout and about 10 in head; snout long, narrow, with rounded tip, interorbital space equal to diameter of eye; mouth large with curved jaws so that it cannot close completely, and opens much farther back on one side than on the other, its greatest extent twice in head; tube of anterior nostril nearly one-third the length of snout; posterior nostril over anterior margin of iris; dorsal low, its origin about one-sixth the length of head

in advance of gill opening, which is four-fifths as large as eye; greatest width of head a little more than 3.5 in its length.

Teeth all conical, sharp, and strongly slanted backward, in a single row in both jaws; ten maxillary teeth on each side and about twelve much larger ones on intermaxillary, with three long depressible fangs in a central row, the posterior one very long; five small, short, pointed teeth far back on vomer; twenty to twenty-two teeth on each side of lower jaw, the first two pairs being large fangs.

Color in life clear brilliant brown with five longitudinal rows of irregularly shaped black spots and blotches which form more or less broken and irregular crossbands, narrower than the interspaces, and best developed on fins; head more or less ruddy and mottled with white and brown; a large blackish blotch behind eyes has a short narrow white line above it and a more distinct, wider, and longer white band which extends to upper lip below eyes; another white stripe from front margin of eyes to middle of maxillary; a black blotch in angle of jaws bordered anteriorly by a narrow elongate white stripe on mandible; a white median line in the the dusky area under posterior portion of mandibles; chin and throat with narrow white transverse lines; pores of jaws white.

Color in alcohol similar but faded, especially on head which is dull colored, the white becoming dingy or disappearing.

Here described from the type of *Gymnothorax indong*, Bureau of Science collection No. 4445, from Zamboanga, Mindanao. This handsome little eel reaches a length of more than 450 millimeters, and is known elsewhere from Tahiti, Rotuma, and the south coast of Java.

#### *Gymnothorax philippinus* JORDAN and SEALE.

*Gymnothorax philippinus* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 26 (1906) (1907) 7, fig. 2.

Head 3.45 in trunk; length of head and trunk greater than tail by a distance equal to length of snout; eye rather large, 1.9 in snout; length of mouth to angle 2.4 in head; a single row of sharp pointed teeth in lower jaw; teeth in upper jaw in a single row, reinforced by 3 or 4 additional teeth in palatine series; three large fang-like vomerine teeth in front, with a row of smaller ones extending back; anterior teeth large canines; fins of moderate height.

Color in spirits, everywhere powdered with yellow and brown, lighter on belly and chin, darker on posterior two-thirds of body, which shows rather wide indistinct darker bands; a distinct black blotch at angle of

mouth, which unites with a black band around chin; a second dusky blotch midway between angle of mouth and gill opening; gill openings uncolored; fins dark without white margins.

I have not seen the above-named and perhaps doubtful species, which was described from the type and only specimen, 23 inches (about 585 millimeters) long, and came either from Manila Bay or from near Iloilo.

*Gymnothorax richardsoni* Bleeker. Plate 11, fig. 4.

*Muræna richardsonii* BLEEKER, Nat. Tijdschr. Ned. Ind. 3 (1852) 296; GÜNTHER, Fische d. Südsee 3 (1910) 414.

*Gymnothorax richardsoni* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 100, pl. 42, fig. 2; EVERMANN and SEALE, Bull. U. S. Bur. Fisheries 26 (1906) 56.

*Gymnothorax richardsonii* JORDAN and RICHARDSON, Bull. U. S. Bur. Fisheries 27 (1907) (1908) 240.

*Gymnothorax scoliodon* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 101, pl. 40, fig. 2.

*Gymnothorax ceramensis* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 101, pl. 33, fig. 3.

*Muræna richardsoni* WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 383, fig. 189.

Depth 12 to 21.1 in total length, head 5.75 to 8, and 2 to 2.78 in trunk; tail approximately the length of head and trunk or it may be as much as 0.14 longer or shorter; eyes moderately large, 8 to 11.6 in head, and 1.25 to 2 in the short snout, which goes 5 to 7.5 in head; the large horizontal mouth closes entirely, and is 2.2 to 2.6 in head; origin of dorsal a little before or over gill openings, which are as wide as or smaller than eyes; teeth vary much with age; maxillaries with twelve to fourteen short compressed teeth in outer row and one to four much longer depressible canines in an anterior inner row, or with age maxillary teeth reduced to five, six, or eight, with no inner row; intermaxillary plate with an outer row of eight to sixteen teeth hardly larger, and one to four, usually two or three, depressible mesial canines, the posterior ones much the longest; occasionally they are lacking; vomerine teeth small and highly variable, from eight or ten in a single row, or five pairs, through all sorts of irregularities to twenty or more partially or completely biserial; lower jaw with from twelve to twenty teeth on each side, and often with one to three pairs of larger teeth forming inner rows near symphysis.

Color of living specimens light grayish, everywhere marked with irregular, dendritic, anastomosing purplish to purplish

brown marblings, which usually form more or less definite transverse bands, especially on tail; belly and throat paler, the markings there much reduced or forming only irregular spots and marks; on the head they may fuse so that the ground color merely shows as more or less stellate spots on sides; no dark patch at angle of mouth, though inside of mouth is often marked with dark flecks; no dark patch around gill openings.

In alcohol the colors are usually much duller, the ground color ordinarily becoming brownish or yellowish and the markings sometimes nearly or quite obsolete. Occasionally specimens are mottled with light and dark, the vertical crossbands and reticulations but little evident.

This species is common in the Philippines, and in the coral sand beaches at Sitanki and at similar localities it swarms in countless numbers. I have examined numerous specimens, ranging in length from 150 to 322 millimeters, collected at Sitanki, Davao, Dumaguete, Cabalian on Leyte Island, Caldera Bay, Mindanao, and Puerto Galera, Mindoro. It has been recorded from reefs near Cebu, by Günther; from San Fabian, Pangasinan, by Evermann and Seale; and from Sibuyan, by Jordan and Richardson. The last named state their specimen had "corner of mouth with a dark streak, above and below (in front) which is a larger pale spot." I have a specimen 290 millimeters long from Cabalian, Leyte, which agrees in the main with *Gymnothorax richardsoni* but has a small dark streak at corner of mouth. It is probable that this mark does occur, though rarely, in this species. In body color and general appearance this eel is often indistinguishable from certain other species, such as *pictus*, *chilosilus*, and *undulatus*, so that it is very difficult to arrive at a definite conclusion with regard to certain specimens, especially where the species is so variable as is the present one. From *pictus* it may easily be separated by the long fangs on the intermaxillary plate, but when the colors and markings are faded it may be impossible to separate it from the other two. The presence of so-called scale pouches on the skin, formed by the crisscrossing of skin folds, is a character strongly stressed by certain authors, but it occurs in so many species that I have not used it as a diagnostic character and attach no particular importance to it. This species has a rather compressed form, is of small or medium size, not reaching a meter in length, and in life is one of our handsomest eels. It is very widespread, occurring from Zanzibar and Socotra to the Philippines, Australia, and the islands of the South Pacific.

*Gymnothorax kidako* (Schlegel).

*Muræna kidako* SCHLEGEL, Fauna Japonica, Poiss. (1846) 266, pl. 117.  
*Muræna similis* RICHARDSON, Voyage Erebus and Terror, Fishes (1844-48) 83.

*Muræna nubila* GÜNTHER, Cat. Fishes Brit. Mus. 8 (1870) 117, pro parte syn. et text.

*Gymnothorax kidako* JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 881.

Depth 2.12 in head and 16.37 in total length; head 7.7 in total length, 4.17 in tail, and 2.53 in trunk; head and trunk together a little shorter than tail, which is a little more than 54 per cent of the whole length; eyes contained 10.2 in head and twice in snout; width of gill openings four-fifths the diameter of eyes; mouth large, its cleft 2.2 in head; maxillaries have sixteen to eighteen small teeth, becoming smaller posteriorly, with two to three longer depressible teeth forming an inner row opposite anterior end of outer row; intermaxillary plate with about twelve large, pointed, fixed teeth in outer row and three mesial, needlelike, depressible canines, the posterior one longest; eight small rounded teeth forming an irregular partially double row on vomer; twenty to twenty-five teeth in each lower jaw with three pairs of larger teeth near symphysis. Origin of dorsal approximately one-third the length of head forward of gill openings, its height a trifle more than one-third the body depth at middle of trunk or at anus.

Color in alcohol rich purplish dark brown, somewhat darker posteriorly, spotted with irregular lichenlike whitish blotches, which join to form irregular transverse bands on trunk and dorsal fin; on posterior half of tail they become reduced to three and then two rows of spots; anal fin with a dark brown band and a very distinct white margin; buccal grooves with dark streaks; lining of mouth and throat dark purplish and apparently angle of mouth had a dark spot; dorsal colored like body.

Here described from a specimen taken by Gregorio Lopez, of the Bureau of Science, from the stomach of a sea snake, *Laticauda colubrina*, at Santo Domingo de Basco, Batan Island, Batanes Province, November 20, 1921. It bears a very close resemblance in both color and shape to the figure of *Aemasia lichenosa* Jordan and Snyder.<sup>11</sup> Jordan and Snyder note the resemblance between these two eels but state that the pale edge of the anal in *Gymnothorax kidako* separates it at sight. In

<sup>11</sup> Proc. U. S. Nat. Mus. 23 (1901) 883, fig. 20.

in this specimen the measurements of the eyes and snout are only approximate and it is impossible to note the coloration of the anterior part of the head (except that there was apparently a black or very dark spot in the angle of the mouth) because digestion had begun in the snake's stomach, removing the skin of the anterior two-thirds of the head and partially destroying the eyes; the rest of it is uninjured.

I have compared this specimen very carefully with Schlegel's original description, as well as with that given by Jordan and Snyder, and cannot place it elsewhere although in color it is very much unlike Schlegel's figure. Jordan and Snyder state that the teeth are "all in single series," but this does not agree with the dentition of the Bureau of Science specimen. But Schlegel says "Toutes ces dents sont du reste assez sujettes à varier tant sous le rapport de leur nombre que sous celui de leur grandeur et de leur forme; il arrive même quelquefois, que les dents sont assez irrégulières et que celles de la deuxième moitié de la mâchoire supérieure se trouvent disposées sur deux ou même sur plusieurs rangées."

This species reaches a length of 3 feet (1 meter) and is common on the coasts of Japan, where Schlegel states it is much sought after, owing to its exquisite flavor.

Our specimen has the following dimensions: Length, 393 millimeters; head, 51; trunk, 129; tail, 213; depth, 24; eye, 5; snout, 10; gape, 23; gill opening, 4.

#### *Gymnothorax pseudothyrsoideus* Bleeker.

*Muræna pseudothyrsoidea* BLEEKER, Nat. Tijdschr. Ned. Ind. 3 (1852)

778; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 384.

*Gymnothorax makassariensis* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 104, pl. 46, fig. 2.

*Gymnothorax pseudothyrsoideus* BLEEKER, Atlas Ichth. Muræn. 4 (1864) 104, pl. 37, fig. 3; JORDAN and RICHARDSON, Mem. Carnegie Mus. 4 (1909) 173.

Depth 14 to 20 in length, head 7 to 8, and 2.6 to 2.9 in trunk; tail shorter than head and trunk together; eye 8 to 12 in head and one and a half times to twice in snout; the wide mouth does not shut completely in large specimens, its gape 2.1 to 2.3 in head; vertical fins rather well developed, dorsal beginning one-fifth to one-half the length of head in advance of gill openings, which are as large as or smaller than eyes; maxillaries with one row of about twelve compressed teeth, young specimens with an inner row of one to three larger ones at forward end; intermaxillary plate with an outer row of ten to twelve teeth

and a central row of one to three canines; vomer with a single row of from three to nine small teeth; mandibles with a single row of about nineteen on each side; in young specimens the teeth near symphysis may be irregularly two rowed.

Color in alcohol brownish to rather dark brown, finely reticulated or marbled everywhere with lighter, or with more or less conspicuous very fine white or yellow lines; chin and belly scarcely paler than upper parts; occasionally almost uniform dark brown. There is no black around gill opening and no light border to fins except at tip of tail. This species reaches a length of over 560 millimeters.

There is a small specimen of this moray in the museum of Santo Tomas, presumably collected in Manila Bay. This species was described by Bleeker from Celebes and Amboina, and occurs rarely from Zanzibar and Muscat to Formosa and Darnley Island, which lies between New Guinea and Queensland, Australia.

#### Genus **ANARCHIAS** Jordan and Seale

*Anarchias* JORDAN and SEALE, Bull. U. S. Bur. Fisheries 25 (1905) (1906) 204.

This genus differs chiefly from *Gymnothorax*, which it otherwise closely resembles, in having no anal; from *Uropterygius* it differs in having a fully developed dorsal fin.

#### *Anarchias reticulatus* sp. nov. Plate 9, fig. 3.

Depth 18 to 21.7 in length and 2.2 to 2.5 in head, which goes from 8.1 to 8.27 in length and 2.8 to 2.95 in trunk; head and trunk together shorter than tail, being contained in it 1.08 to 1.14; eye small, 12.5 to 15 in head and 1.7 to 2 in snout, which is  $7\frac{1}{8}$  to  $7\frac{1}{2}$  in head; mouth wide, closing completely, its gape 2.93 to 3.14 in head; two rows of teeth in both jaws; outer row of very small, fixed, pointed teeth, inner of depressible caninelike teeth of much greater length, usually more than twice as long; two still longer median canines on intermaxillary plate, the second one very long and fanglike; a short row of six small, sharp-pointed, depressible teeth on vomer.

Head narrow, jaws subequal, lower inclined to project slightly; gill openings smaller than eyes; dorsal beginning far forward of gill openings; anal absent or reduced to a rudiment which is confluent with the small caudal.

Color in alcohol gray or warm reddish brown, everywhere covered with irregular dark lines and markings, more or less

dendritic and anastomosing or reticulate; the markings wider and darker above, so that dorsal half is more or less dusky, ventral half relatively pale; interspaces between markings sprinkled with very minute dark dots.

Here described from three small specimens, 122, 179, and 182 millimeters in length, dug out of the coral sands at Sitanki.

This is closely related to *Uropterygius marmoratus* but seems to be sufficiently distinct from *Gymnomuræna marmorata* as defined by Weber and Beaufort.

### Genus UROPTERYGIUS Rüppell

*Uropterygius* RÜPPELL, Neue Wirbelthiere, Fische (1835) 83; JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 886.

*Gymnomuræna* WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 392.

This group comprises long or very long morays in which the fins are altogether wanting or developed only at tip of tail; the typical species have the tail as long as or longer than head and trunk, but it may be considerably shorter; anterior nostrils in tubes, posterior nostrils with low rims only; eye small, covered by skin; cleft of mouth reaching behind eye, closing almost or quite completely; no pectorals; gill openings small, in middle of body height, or above or below; teeth in two or three series, more or less compressed, pointed, the larger ones deppressible; vomer with one or two rows of pointed teeth.

Coral-reef or shore-dwelling eels of the warmer parts of the Indian and Pacific Oceans.

#### *Key to the species of Uropterygius.*

- a<sup>1</sup>.* Color uniform brown..... *U. concolor.*
- a<sup>2</sup>.* More or less spotted, marbled, or reticulated.
  - b<sup>1</sup>.* Gill openings about middle of height, two or three rows of teeth in jaws..... *U. marmoratus.*
  - b<sup>2</sup>.* Gill openings high above middle line; teeth very numerous, forming bands..... *U. supraforatus.*

#### *Uropterygius concolor* Rüppell.

*Uropterygius concolor* RÜPPELL, Neue Wirbelthiere, Fische (1835) 83; JORDAN and SEALE, Proc. U. S. Nat. Mus. 28 (1905) 772.

*Gymnomuræna concolor* WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 395.

Robust, smooth, and finless, the elongate subcylindrical trunk becoming compressed posteriorly; tip of tail with a very small caudal into which the vestigial dorsal and anal fins merge; origin of dorsal about twice diameter of eye forward of tip of tail.

Depth about 18 to 33 in length; head from 7.1 to nearly 10.4; tail equal to, somewhat shorter, or somewhat longer than head and trunk.

A specimen from Zamboanga has the following dimensions: Length, 790 millimeters; head, 76; tail, 357; trunk, 357; depth, 36. Eye 6 millimeters in diameter and contained twice in snout, which is heavy, blunt, and rounded and contained  $6\frac{2}{3}$  in head; mouth wide, closing completely, its horizontal cleft about 3 in head and reaching far beyond eye which is forward of middle of jaw; anterior nostrils on front of snout; posterior nostrils on top of head forward of eyes and with well-developed rims; their interspace twice in distance from tip of snout to posterior margin of eye.

The heavy jaws are subequal, with two rows of teeth in each; those in outer series much smaller, compressed, and close set; in mandible outer row is composed of numerous sharp-pointed teeth, inner row of a few long canines; in both jaws teeth in inner series much the longer and depressible; outer maxillary series continued on intermaxillary plate, the teeth much smaller and inclosing numerous longer, depressible, irregularly placed teeth; a row of five or six large, pointed canines on vomer. Color uniform dark chocolate brown, skin thick and leathery.

Another small specimen from the same locality has the following measurements: Length, 330 millimeters; head, 40; tail, 170; trunk, 120; depth, 17; color reddish brown. Pores on lips and chin large and conspicuous as in Bleeker's figure of *Gymnomuræna pantherina*. This specimen resembles *Uropterygius marmoratus* in some respects but has the dentition of *concolor*. Five small specimens from Calapan, Mindoro, ranging in length from 106 to 115 millimeters, are typical in every respect except in their greater proportionate depth. The pores on jaws and snout are very noticeable in these specimens. Another specimen, from Iba, Zambales, having a length of 244 millimeters, is also typical. Previously recorded from southern Negros by Jordan and Seale.

A widely distributed eel, but according to Günther not common anywhere. It is found from the Red Sea and Mauritius to the Philippines, Australia, and the Society Islands.

#### *Uropterygius marmoratus* (Lacépède).

*Gymnomuræna marmorata* LACÉPÈDE, Hist. Nat. Poissons 5 (1803) 648; DAY, Fishes of India (1878-88) 675; GÜNTHER, Fische d. Südsee 3 (1910) 425; WEBER and BEAUFORT, Fishes Indo-Austr. Arch. 3 (1916) 397, figs. 193, 194.

*Gymnomuræna pantherina* BLEEKER, Atlas Ichth. Muræn. 4 (1864)  
113, pl. 31, fig. 3.

*Gymnomuræna xanthopterus* BLEEKER, Atlas Ichth. Muræn. 4 (1864)  
114, pl. 20, fig. 4.

*Gymnomuræna micropterus* BLEEKER, Atlas Ichth. Muræn. 4 (1864)  
115, pl. 20, fig. 2.

*Uropterygius marmoratus* JORDAN and EVERMANN, Bull. U. S. Fish  
Comm. 23 (1903) (1905) 111, fig. 33.

Depth 14 to nearly 21 in total length (19 to 26, according to Weber and Beaufort); head 8.1 to nearly 11 in total length and 2.75 to 3.86 in trunk; head and trunk together 1.09 to 1.2 in tail, which is from one-half to four-fifths of head longer than head and trunk together in my specimens; eye small, 10 to 15 in head and 1.6 to 2 in the rounded snout; mouth wide, 2.7 to 3 in head, and closing completely; anterior nostrils with a conspicuous tube, posterior ones with a rim or short tube, according to age; teeth in jaws in two rows in young specimens, in three rows in older ones, outer row composed of very small, pointed, fixed teeth; inner row or rows of much larger and therefore less numerous, long, depressible canines; the two outer rows of maxillary teeth continued around intermaxillary plate and inclosing two to several larger, depressible canines; vomer with a short row of seven or eight tiny teeth in my specimens; larger examples have them more numerous and in two rows anteriorly; both dorsal and anal entirely absent.

In alcohol a pale yellowish or gray ground color, everywhere reticulated or marbled with more or less anastomosing, dendritic, purplish dark markings which are very numerous and coarser dorsally, finer and less numerous below, so that throat and belly are pale.

I have two small specimens from Sitanki, 153 and 166 millimeters in length. The smaller one is a female nearly ready to spawn, and her swollen trunk is in very marked contrast to her slender head and tail. This specimen, though very small and apparently adult, seems to agree in all essentials with *G. marmoratus*, the head being contained nearly 11 times in total length, and the color being characteristic. A third specimen, locality unknown, 106 millimeters long, agrees with the others except in color; it is blackish brown with numerous darker marblings which are very indistinct on the dark ground color.

This eel reaches a length of more than two feet (60 centimeters) and is found throughout the tropical Indian and Pacific Oceans from Zanzibar to the Philippines, Hawaii, Samoa, and the Marquesas.

*Uropterygius supraforatus* (Regan).

*Gymnomuræna supraforata* REGAN, Ann. & Mag. Nat. Hist. VIII 4 (1909) 439; GÜNTHER, Fische d. Südsee 3 (1910) 426, figure in text.

Depth 18.5 in total length, head 10.5 to 11, and 4.6 in trunk; head and trunk together a little shorter than (1.09 in) tail; eyes large, 7.7 in head and about 1.3 in the broad, rounded snout, forward of middle of the large mouth which closes completely and is 1.9 to twice in head; posterior nostrils behind middle of eye, with elevated rims; gill openings high up, located four-thirteenths of depth below dorsal profile; vertical fins very low, poorly developed, dorsal ridge beginning about length of head, anal less than that forward of tip of caudal, with which they are confluent. Teeth excessively numerous, all depressible; in both upper and lower jaws an outer row of very small, pointed, laterally compressed teeth after which comes a band of similar but slightly higher teeth, containing four rows in upper jaws



FIG. 14. *Uropterygius supraforatus* (Regan), dentition; a, upper jaw; b, lower jaw.  $\times 1.5$ .

and three or four in mandible; bands taper posteriorly to one or two rows; then follow two or three rows of very long, sharp, depressible, needlelike canines, arranged in two rows anteriorly, in three rows on the maxillaries, the innermost row being conspicuously the largest; the mandible with three rows of long depressible canines, those of innermost row largest; vomer with two slender, short, sharp-pointed teeth; according to Regan the vomerine teeth form a short band. A median row of three long depressible canines on the intermaxillaries.

A moderately slender eel with rather blunt tail, the skin very thick and leathery.

Color in alcohol pale yellowish brown, with numerous, often circular, dark reddish spots which often tend to form vertical series, especially posteriorly; spots smaller and more numerous on sides of head, jaws, and throat.

I have examined one specimen of this very distinct species, obtained from the stomach of a sea snake, at Cresta de Gallo, a rock near Sibuyan. Previously known from a specimen from Savaii and three smaller ones from Tahiti. My specimen is practically identical in size with the type in the British Museum, its measurements being as follows: Length, 277 millimeters; head, 27; trunk, 125; tail, 155; eye, 3.5; snout, 4.5; gape, 14.

## ILLUSTRATIONS

[Drawings on plates not credited to Espinosa were made by M. Ligaya.]

### PLATE 1

FIG. 1. *Anguilla spengeli* M. Weber;  $\times 0.5$ .  
2. *Ariosoma obud* sp. nov.;  $\times 1$ .  
3. *Uroconger lepturus* (Richardson);  $\times 1$ .

### PLATE 2

FIG. 1. *Murænichthys malabonensis* sp. nov;  $\times 1$ .  
2. *Cirrhimuræna oliveri* (Seale);  $\times 1$ .

### PLATE 3

*Tænioconger chapmani* sp. nov.;  $\times 1$ .

### PLATE 4

*Chlevastes colubrinus* (Boddaert);  $\times 1$ .

### PLATE 5

*Ophichthus manilensis* sp. nov.;  $\times 2$ .

### PLATE 6

FIG. 1. *Lamnostoma orientalis* (McClelland);  $\times 1$ .  
2. *Cæcula taylori* sp. nov.;  $\times 1$ .

### PLATE 7

*Moringua robusta* sp. nov.;  $\times 0.5$ .

### PLATE 8

*Moringua cagayana* Seale;  $\times 1$ .

### PLATE 9

FIG. 1. *Gymnothorax undulatus* (Lacépède);  $\times 0.25$ .  
2. *Aphthalmichthys macrocephalus* Bleeker;  $\times 1$ .  
3. *Anarchias reticulatus* sp. nov.;  $\times 1$ .

### PLATE 10

FIG. 1. *Murænesox cinereus* (Forskål), head, from a photograph.  
2. *Myrichthys maculosus* Cuvier, from a photograph.  
3. *Echidna nebulosa* (Ahl), from a color sketch by T. S. Espinosa.  
4. *Echidna rhodochilus* Bleeker;  $\times 2$ .

## PLATE 11

1. *Gymnothorax chilosialis* Bleeker;  $\times 2$ .
2. *Gymnothorax favagineus* Bloch and Schneider, from a photograph.
3. *Gymnothorax zonipectis* Seale, from a color sketch made at Zamboanga, by T. S. Espinosa.
4. *Gymnothorax richardsoni* Bleeker, from a color sketch made at Sitanki, by T. S. Espinosa;  $\times 0.5$ .

## TEXT FIGURES

[Original drawings by Herre.]

FIG. 1. *Anguilla celebesensis* Kaup, dentition; *a*, vomer and maxillaries; *b*, mandibles. After Weber and Beaufort.

2. *Muraenichthys gymnopterus* Bleeker, dentition; *a*, intermaxillaries; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 3$ .

3. *Pisodonophis boro* (Hamilton Buchanan), dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 2$ . After Weber and Beaufort.

4. *Ophichthus cephalozona* (Bleeker), dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 2.5$ .

5. *Ophichthus grandoculis* (Cantor), dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 3$ .

6. *Ophichthus celebicus* (Bleeker), dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandible.  $\times 3$ .

7. *Cæcula taylori* sp. nov., dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 4$ .

8. *Moringua cagayana* Seale, dentition; *a*, intermaxillaries; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 5$ .

9. *Aphthalimichthys macrocephalus* Bleeker, dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 4$ .

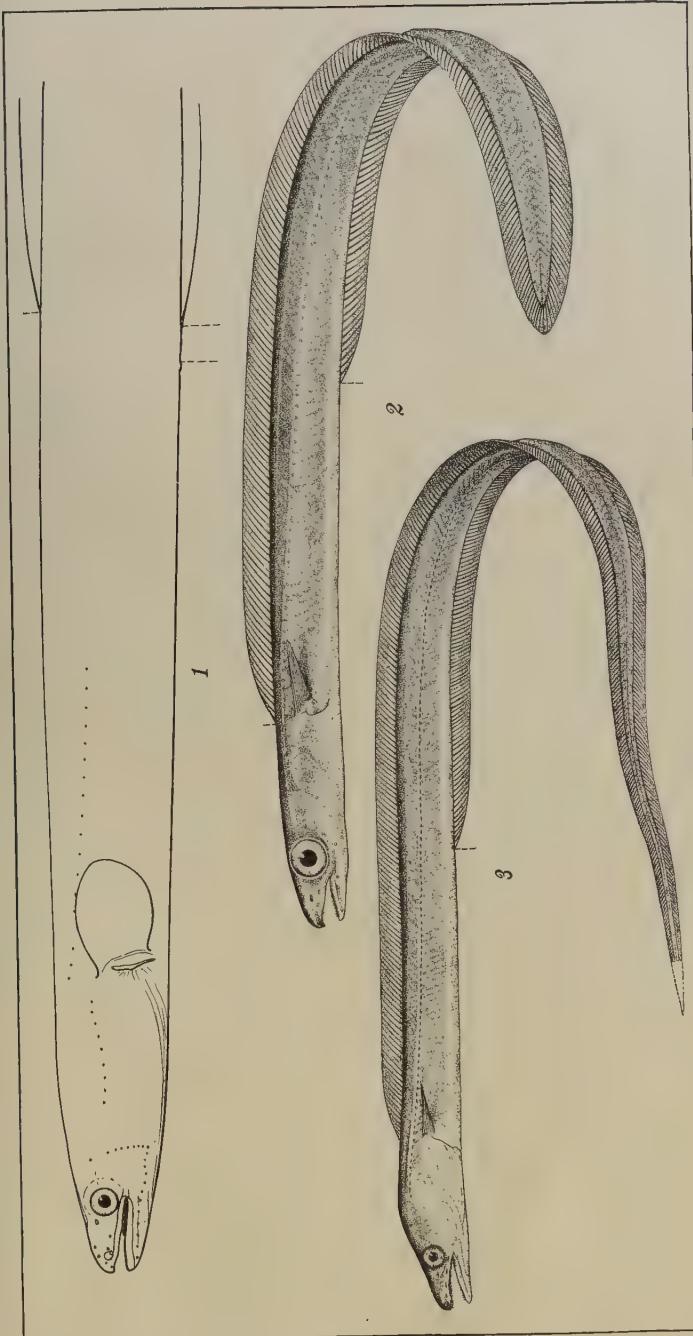
10. *Echidna delicatula* (Kaup), dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 4$ .

11. *Echidna amblyodon* Bleeker, dentition; *a*, intermaxillary plate; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 4$ .

12. *Gymnothorax pictus* (Ahl), dentition of two specimens, showing variation; *a*, intermaxillary; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 2$ .

13. *Gymnothorax brunneus* sp. nov., dentition; *a*, intermaxillary; *b*, maxillaries; *c*, vomer; *d*, mandibles.  $\times 4$ .

14. *Uropterygius supraforatus* (Regan), dentition; *a*, upper jaw; *b*, lower jaw.  $\times 1.5$ .





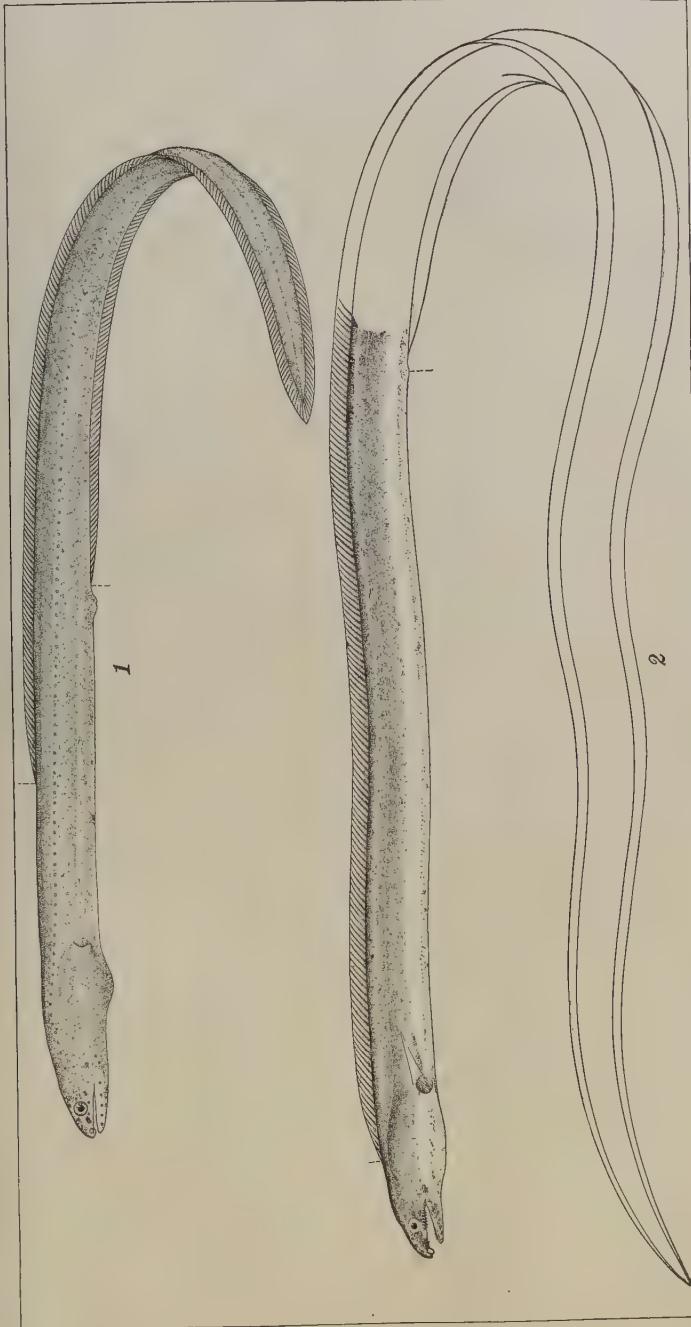


PLATE 2.









PLATE 4. *CHLEVASTES COLUBRINUS* (BODDAERT).



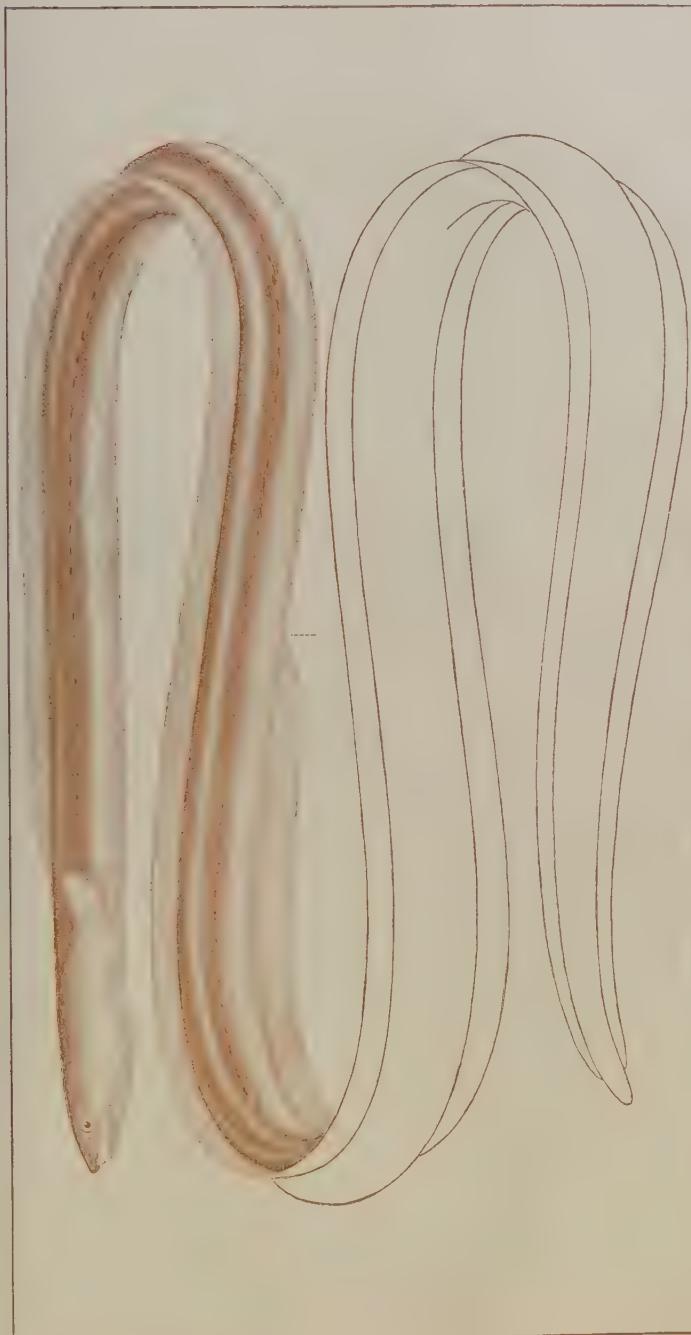


PLATE 5. *OPHICHTHUS MANILENSIS* SP. NOV.



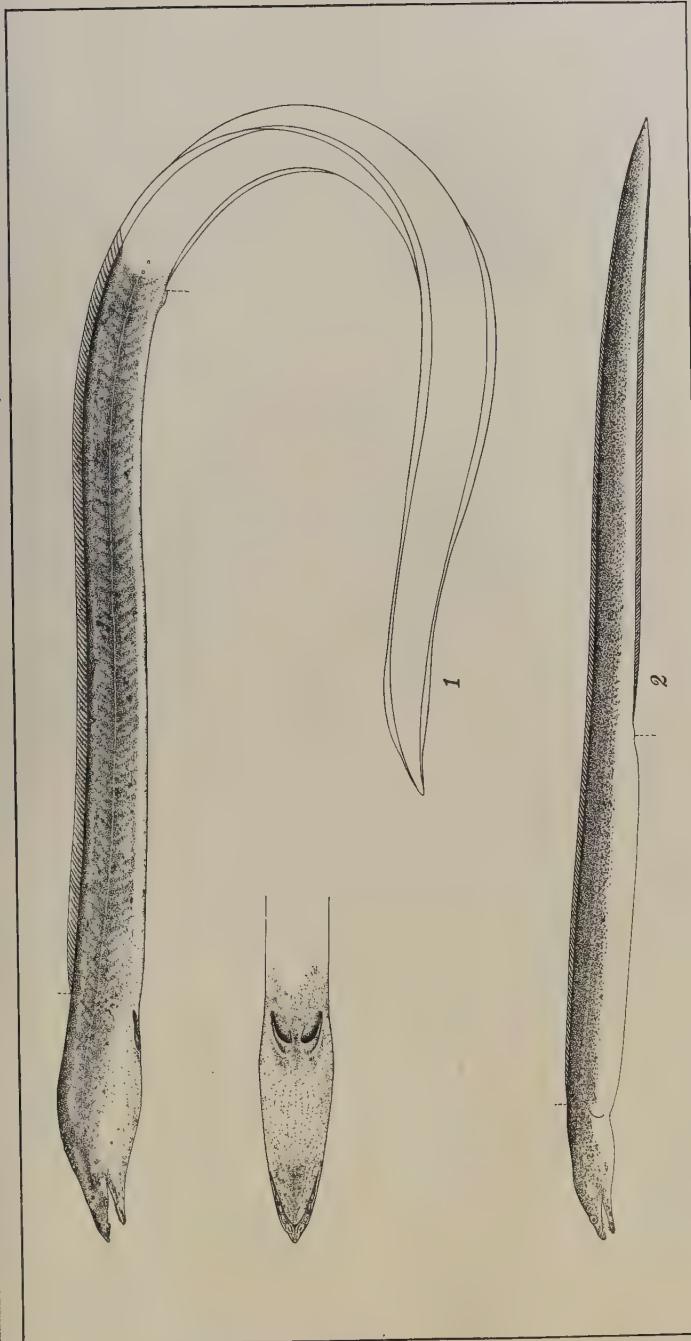






PLATE 7. *MORINGUA ROBUSTA* SP. NOV.



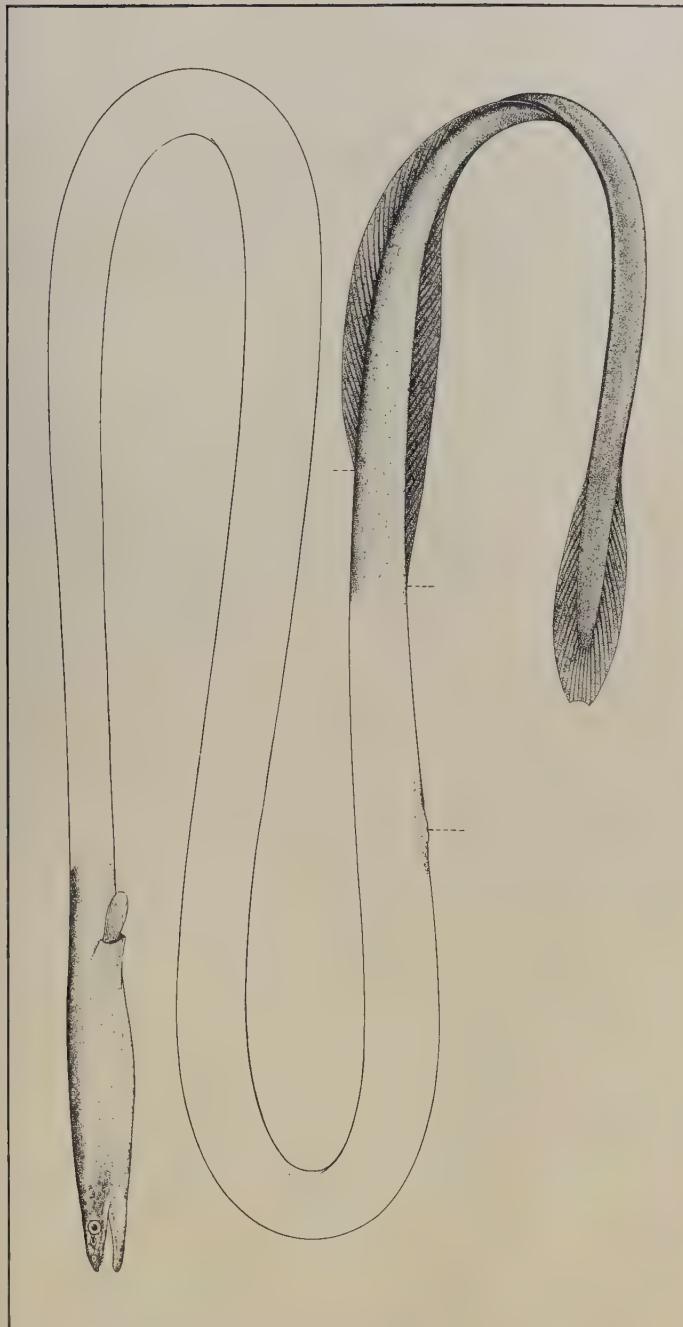


PLATE 8. MORINGUA CAGAYANA SEALE.



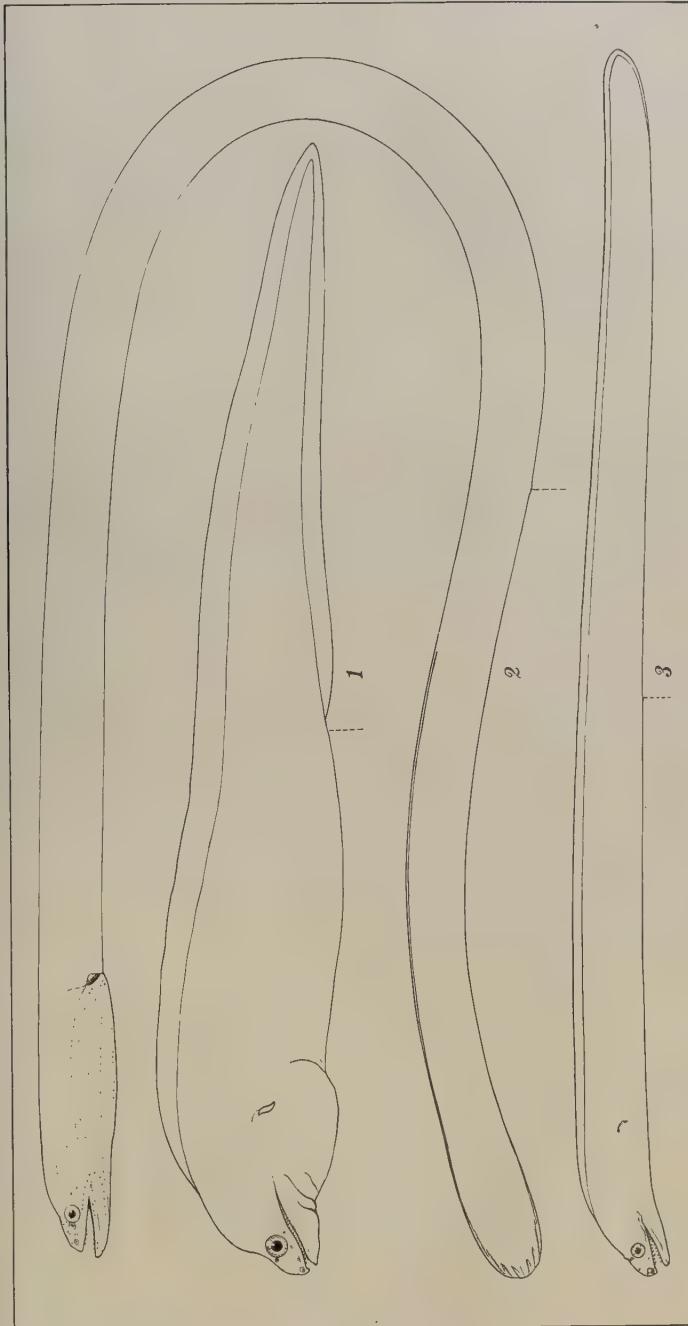
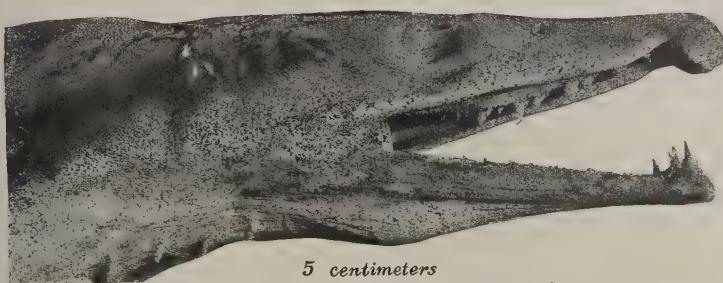


PLATE 9.





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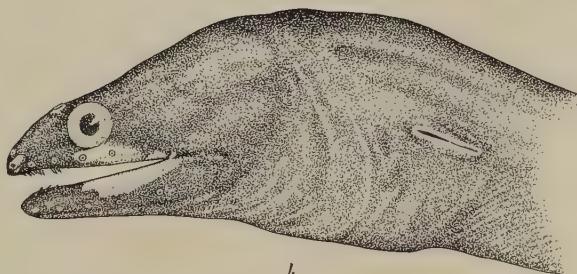
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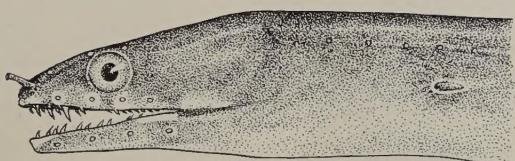


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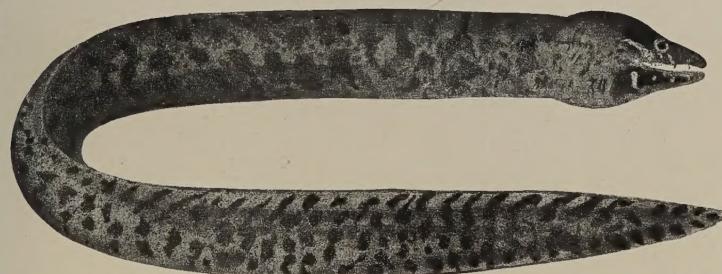




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